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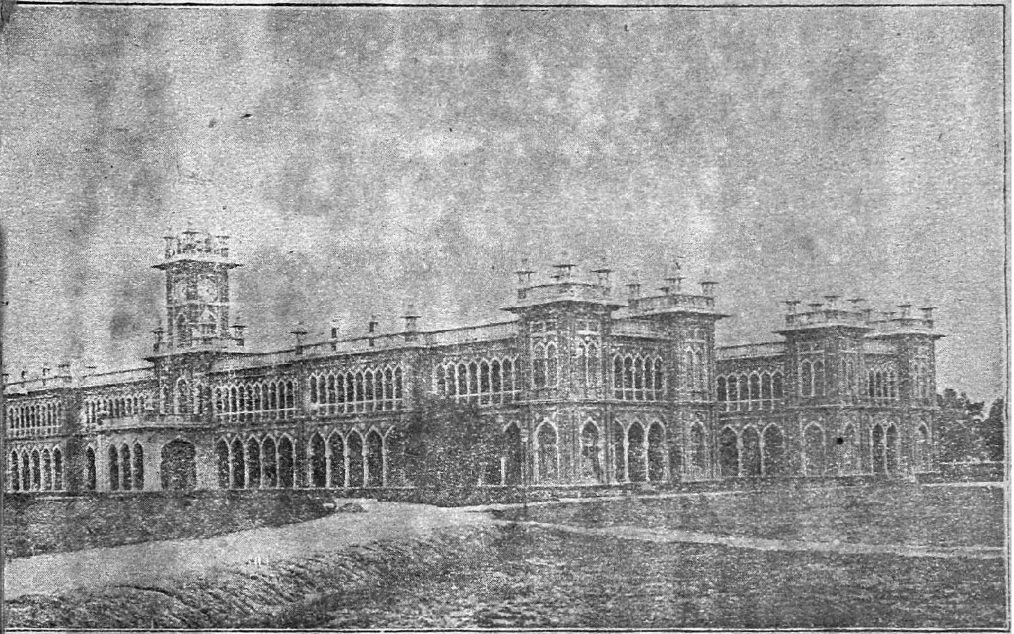
XLI January 1954 No. 1



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The Late Rao Bahadur S. SUNDARARAMIER

The news of the death of Mr. S. Sundararamier, former Mycologist, Government of Madras, at Kumbakonam on Friday the 22nd January 1954 must have come as a shock to many of his old colleagues and students and members of the Union. Having retired in 1936 after a long and meritorious service of 31 years, the late Mr. Iyer, had of course lived to the Psalmist's "Three score years and ten", but he had been maintaining such good health and active habits during his retirement that the end just now was unexpected.

Mr. Sundararamier was born in the year 1881 in a very cultured family of South India. His father the late Mr. S. Subramani Iyer was a veteran educationist and a well known figure in the educational department, in the early years of this century. Mr. Sundararamier after a brilliant academic career, underwent his early training under Dr. Butler, the eminent Mycologist. Entering the Agricultural Department as an assistant in Botany, he gradually rose step by step until in 1922, he was elevated to the Imperial Service as Government Mycologist, Madras. He held this post till 1936, when he retired.

The remarkable feature of Mr. Sundararamier's work and administration as a Mycologist was his practical outlook, full of commonsense he had the knack of putting across to the ryots, remedial measures in language which they easily understood, and with equipment they could easily get hold of. In fact, he emphasised more attention on the utilitarian aspect than on the fundamental side of research.

Simple and unassuming in habits, shunning the limelight, sincere in his devotion to duty and service to the cultivators, Mr. Sundararamier endeared himself to his colleagues and students. He was intimately connected with the Union from its inception and was its Vice-President in the Jubilee year. He was also connected with the Officers' Club, the Public Servants Co-operative Society, the Association of Economic Biologists, in all of which he was President during various periods.

To his wife, who survives him and to the members of his bereaved family, the Union conveys its heartfelt condolences.

May his soul rest in peace.

The Madras Agricultural Journal

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Editorial

The theory of agricultural practices seems to be in recent times taking a turn towards the older ones, especially, in reference to India. In this country it was vehemently advocated that the native wooden chisel plough was very defficient and for a good farming iron mould board ploughs capable of turning the soil should be used. Quite a large number of them was manufactured to suit the Indian conditions. A clean level field with no weeds growing nor any other disfiguring stubbles left on the field was held as the ideal. Constant working of the barrows and occasional deep ploughing etc., were advocated. Even stones and pebbles were not allowed to be left in the field. Advocacy on manures, however, was more cautious, yet the stress was more towards the chemical fertilizers. Recent investigations have shifted the weight again. It is now advocated that it is better to leave the soil undisturbed and for this a chisel plough which just works undersurface, and breaks the pan created by working of heavier iron ploughs is advised. The stubbles are to be left in the field and the latter left in as rough a manner as possible since a finely worked, clean surface is liable to get compacted with the first rains and thus more water run off than absorbed. It is said further to lower the soil erosion. Organic manures especially farm yard manure recommended as the best method of improving the soil, encouraging the growth of soil microflora and fauna and preventing certain pathological conditions in the plants. Pebbles and stones unless they are flat granites which might prevent root and water penetration are now to be left in the field since they add to the soil by gradual disintigration and supply some of the precious rare elements found to be so necessary now for plant growth. We are also told that land which has been put to grass for a few

seasons recovers its fertility quickly and at the same time soil erosion is checked. Thus it becomes evident that some of the time honoured practices though emperical may after all be found to have a fundamental basis and should be carefully investigated before rejection or substitution.

Republic Day: On the 26th of January the fourth anniversary of the Republic of India was observed throughout the country. In a review of the progress during the few years since attainment of independence the public were given an opportunity to see the advances attained in a number of fields of public utility, like agriculture, irrigation, health, education, transport, defence etc. At the same time it was reminded that it was not yet time to rest their oars but it was only a signal for further activities in all fields. We pray that the Republic may march from strength to strength in all activities for the well being of the Nation.

Progress of Cotton Research in Madras *

By

S. M. KALYANARAMAN

Cotton Specialist

Research in cotton in the State of Madras is directed towards the improvement of the various commercial cottons cultivated in this State in the different cotton tracts, namely, Cocanadas including *Chinnapathi*, Westerns including Mungari, Northerns including Red and White, Cambodias including Uganda or Rajapalayam cotton, Uppam, Nadam and Bourbon, and Tinnevellies including *Karunganni*. The improvement is sought in maximisation of yield, enhancement of quality, the introduction of resistance to pests, diseases and adverse environmental conditions and the increase of monetary return per acre to the growers of cotton. These improvements are attempted to be achieved by (A) adoption of plant breeding methods utilising the latest techniques, (B) agronomic experiments to determine the most suitable methods of economic cultivation of cotton and (C) the study of fundamental aspects relating to genetical behaviour of the several attributes in cotton and how best they can be utilised in breeding superior varieties. In the following paragraphs an attempt is made to summarise the progress achieved so far under these three heads.

A. BREEDING

1. **Cambodia**: The total area under this variety in this State is 4·10 lakh of acres of which 53·0% are sown to improved varieties. Cambodia cotton is cultivated both as an irrigated and unirrigated crop and during two definite seasons, either as a cold-weather crop sown in September — October and harvested by March — April, or as a summer crop sown in February — March and harvested in August — September. In the former practice sowings are done both under irrigated and rainfed conditions, whereas cotton during summer is confined to irrigated conditions in the East Coast namely South Arcot and in the Southern districts of Madurai, Ramanathapuram and Tirunelveli.

(a) *Irrigated Winter-sown Cambodia:* Cultivation during cold weather is spread over the Central and Southern districts in the State. A scheme for its improvement financed by the Indian Central Cotton Committee, is in operation to improve upon the existing strains of cotton under cultivation namely Co. 2 and M. C. U. 1 (Madras Cambodia Uganda 1). It also envisages the evolution of a cosmopolitan type of Cambodia cotton that would be adaptable for cultivation both in the

* A summary of the report on the progress of cotton research in Madras presented at the meeting of the Heads of Sections and others heldon 16 — 8 — 1952, the Minister for Agriculture, Madras presiding.

Central and Southern tracts where early and late-sown conditions of agricultural practices obtain. This is done with a view to avoid a multiplicity of strains under distribution and avoid the difficulties of maintaining purity and prevent the deterioration of strains under cultivation. The results so far obtained indicate an improvement in staple length by 4 to 5 mm. and in ginning percentage by one to three per cent. The most promising of the cultures under advanced stages of yield trials are Nos. 9030, 0744, 9995 and 0734. It is interesting to note that culture No. 0734 is found to be adaptable not only for the early and late-sown conditions but also for irrigated and unirrigated conditions. The evolution of such a strain will go a long way to bring the entire tract under one improved variety of Cambodia. Under Cambodia improvement work for winter sown conditions may be included the breeding work conducted at the Agricultural Research Station, Siruguppa under the auspices of a Scheme sanctioned by the Indian Central Cotton Committee. The results so far indicate the possibilities of evolving a type of Cambodia suitable for growing in black soils of the Ceded districts with the irrigation facilities that would become available with the advent of the Thungabhara project. H. A. 11, M. A. 2 and Laxmi varieties obtained from other States and acclimatised locally, are seen to come up well under the conditions of the trial. One other important finding as a result of the work at Siruguppa is the possibility of evolving varieties of cotton resistant to pests and diseases. For instance culture 2196 — a reselection from one of the interspecific hybrids of Surat, has been found to be consistently resistant to blackarm. Similarly culture 1821, also isolated at Siruguppa, is found to be definitely resistant to jassids. Apart from the utility of these in the tract for minimising crop losses due to pests and diseases, their use as resistant parents for hybridization work elsewhere in the state offers a wider scope.

(b) *Summer-sown irrigated Cambodia:* It is interesting to record that Cambodia cotton grown under irrigation during summer is as a rule better in quality than the same cotton raised during winter months. Previous research has shown that the conditions of temperature and humidity are more favourable for the development of long and fine fibres during summer than during winter. This experience coupled with the peculiar practice, namely cultivation of Cambodia cotton on single-crop wet lands with well irrigation between the months of February and August, in some parts of Ramanathapuram district, gave an impetus for intensive improvement work on summer cottons. Since this item of research is intended to improve the production of quality cottons in the State, it has received sufficient encouragement at the hands of the State Government as well as the Indian Central Cotton Committee. A Scheme (Long-Staple Cotton Scheme) financed by the Indian Central Cotton Committee was started in the year 1946 and is in progress. The object of this is to evolve varieties of Cambodia cotton suited to summer cultivation

and which possess a mean staple of $1\frac{1}{8}''$ capable of spinning 50's and over. By the adoption of such a procedure it was considered possible to produce long staple cottons which at present are in short supply in the Indian Union. This improvement work is located at the sub-station at Srivilliputhur in Ramanathapuram district. The trials so far made have indicated the suitability of No. 7682 now renamed as Madras Cambodia Uganda 2, to the summer-sown conditions. This cotton is capable of spinning upto 52's as against 44's for which Madras Cambodia Uganda 1 has been found to be suitable. Further, this new strain has been found by district trials to yield 20% of seed cotton more than Madras Cambodia Uganda 1, to possess higher ginning by 2% and to be earlier in duration by nearly two weeks, which feature is specially advantageous for summer cultivation under well irrigation. It is therefore proposed to multiply and distribute Madras Cambodia Uganda 2 in the districts of Madura, Ramanathapuram, Tirunelveli and South Arcot, for summer sowing. Besides this, the results of experiments at Palur have indicated that by a suitable shift in the time of sowing of summer cotton in South Arcot district not only the yields are increased three-fold but also the defect of contabesence of anthers is mostly overcome. In addition to these indications, the trial of *barbadense* types under the East Coast conditions has given very encouraging results and points to the possibility of developing *inter* and *intra-barbadense* hybrids suited to summer conditions. Such crosses are in various stages of trial and when finalised are expected to produce cottons of over $1\frac{1}{8}''$ in staple and suitable for spinning 60's warp yarn.

(c) *Un-irrigated Cambodia and Sea Island cotton:* Nearly one half of the area under Cambodia cotton in this State is normally raised as an unirrigated crop, mainly in the districts of Coimbatore, Salem, Tiruchirapalli and Madurai. Usually, in trade the mixing of the produce of unirrigated Cambodia with that from irrigated Cambodia tended to reduce the quality of the latter. This has spoilt the fair name of irrigated Cambodia in trade circles. Therefore, improvement work on rainfed Cambodia was started with the financial aid of the Indian Central Cotton Committee by the loction of a centre of cotton research at Periyakulam in Madurai district. Though this scheme has been in operation for only three seasons, the results obtained do indicate the possibility of evolving a cotton of one inch and over staple, capable of thriving well under rainfed conditions, yielding on an average 200 lb. of lint per acre and with a quality staple for spinning 40's yarn or better. A few of the cultures — 7604-8, reselection of Co. 4/B. 40 and a reselection from 4-4-1-1 have been found to be even better than Madras Cambodia Uganda 1 in yield and equivalent to it in quality. Under Periyakulom conditions Madras Cambodia Uganda 2 has been found to yield consistently better than Madras Cambodia Uganda 1.

For the unirrigated conditions in the black soils of Ceded districts, isolation of Cambodia types is in progress at Hagari and Nandyal. The results obtained at these centres indicate the adaptability of Laxmi and and a few reselections like 320 and 427 from M. A. 2, for such conditions.

With the object of exploring the possibilities of the cultivation of Sea Island cotton, the quality of which is known to be the best in the world, under West Coast conditions where rainfall, temperature and humidity trends are more or less similar to those in the West Indies, the wrok on acclimatisation and cultivation of Sea-Island in the West Coast was taken up as part of the Winter Cambodia Scheme for the last four seasons. The trials and experiments conducted so far indicate the possibility of successfully cultivating a hardy type of Sea Island cotton under rainfed conditions in the West Coast (Malabar and South Kanara). This possibility is of course conditioned, by the proper adoption of agricultural practices particularly adequate manuring. The present knowledge indicates that intensive manuring, transplanting six week old seedlings and timely prophylactic measures against insect pests are necessary for successfully cultivating this variety in the West Coast. This cotton so raised in the West Coast is found to be capable of spinning over 100 counts and is valued at Rs. 2,500/- per candy as against Rs. 1,000/- for good Cambodia.

Another phase of Cambodia improvement is the utilisation of favourable attributes possessed by certain wild cottons like *G. darwinii* and *G. taitense*, amongst the New World group and *G. raymondii* and *G. anomalum* in the Asiatic group. Study of hybrid derivatives involving the New World group wild cottons and cultivated Cambodia types has indicated the possibilities of evolving hardy types suited to irrigated and unirrigated conditions of Cambodia cultivation. Several promising cultures are under various stages of trial. A few of them have been found to be highly resistant to blackarm disease caused by *Phytomonas malvacearum*.

Another new feature of Cambodia improvement work is the recent attempt to cultivate cotton on the rice fallows in the State. This new line of work has been started in connection with the cotton extension plan which aims at increase in the production of cotton without adversely affecting the production of food crops. This venture was taken up because previous experience had proved the possibility of raising cotton on similar lands during summer in Ramanathapuram district. Moreover, earlier trials of different varieties on the Rice Research Stations in this State had given encouraging results. Based on all these, experiments of co-ordinated nature were conducted to compare several varieties, to determine the optimum date of planting and to assess the response to manurial treatments in thirteen agricultural research stations, after the harvest of paddy crop. The trend of the results so far obtained shows clearly that early duration varieties like P. 216. F and P. 23. F can successfully be introduced in all rice fallows where (a) facilities for irrigation during summer months exist, (b) where temperature - maximum and minimum - do not vary widely, but keep within the optimum limits and (c) where the rice-fallow period permits the cultivation of cotton crop of 4½ to 5 months' duration. Already the success of cotton cultivation on such lands has been proved by the spread of P. 216. F in the rice-fallows of Tanjore district. The varietal trials have indicated that several other types

superior in quality to P. 216. F can be introduced with even greater success. Similarly manurial trials have clearly shown that application of nitrogenous manures, to the extent of 40 lb. nitrogen, contributed to higher yield of cotton. The best time for planting has been observed to be early in January, immediately after the harvest of paddy. The trials are still in progress and when sufficient experience on the suitability of varieties and methods of cultivation including control of pests and diseases have been gained, it would be possible to extend this practice to rice-fallows in other districts and thus increase the production of quality cotton in this State, to an appreciable degree.

2. **Nadam Cotton:** The area under this variety is only 0·06 lakh of acres and is confined to the shallow gravelly soils of the Erode taluk of Coimbatore district. With the advent of the Lower Bhavani project, a major portion of this tract is likely to come under irrigation, though there might be still patches here and there not benefited by the project. Therefore, improvement work on this variety is now restricted in scope. Breeding of early types is being carried out at Coimbatore. As a result culture B. 32-48/51 has been evolved. It is being tested out under ryots' conditions in the Erode taluk for adaptability to that environment. There are also other cultures, equally early but they require to be purified, before they can be tested out in the districts. Further studies with these promising cultures are planned to be carried out at the Agricultural Research Station, Satyamangalam where soil conditions are representative of the Nadam tract.

3. **Karunganni and Tinnevellies:** The normal area under this commercial variety is 5·46 lakh of acres of which 61·5% are already under improved strains, K. 5 in the Central districts and K. 2 in the Southern districts. It may be mentioned that the soil and climatic conditions vary considerably from district to district. Hitherto, no one strain of cotton was found suitable for the entire tract. Therefore, separate strains for the Central and Southern districts were being evolved and distributed from time to time. That, the simultaneous cultivation of more than one strain of Karunganni in contiguous districts was always responsible for mixing of varieties, wilful and otherwise, leading to great difficulties in the maintenance of purity of the strains under cultivation. Therefore, it was programmed to evolve by suitable breeding methods a cosmopolitan type of *arboreum* strain suited to both Central and Southern districts of Madras.

This attempt was greatly encouraged by the results obtained from a study of the progenies of several hybrid cultures at the Agricultural Research Station, Koilpatti where it was found that large variations for economic characters were present and therefore there was ample scope for obtaining useful results by the application of selection methods. Further indications were also there to point out the possibility of longer—stapled cottons capable of spinning upto 40's. Hence, a scheme was put into operation in June, 1949, with the financial assistance of the Indian Central Cotton Committee. During the short period of four years intensive studies of hybrid cultures have revealed that four of them are definite improvements over the existing Karunganni strains and are

adapted to both *Coimbatore* and *Koilpatti* environments. The performance of these in the several Karunganni growing areas is being tested by extensive scattered block trials. The results of these trials are expected to help in selecting the best of these promising cultures. Special mention may be made of cultures 6312-4 and 6874 which have been adjudged to be suitable for spinning 40's yarn consistently for the last three seasons. In ginning percentage and yield they are either improvements over the control or as good as the existing strain. Besides the above cultures quite a large number are in the lower stages of trial which have combined to a remarkable degree quality and yield, and it is expected that one or more of these may be even better than the most promising on hand now.

4. **Cocanadas**: The normal area under this variety is 0·96 lakh of acres of which 21·6% are now occupied by the improved strain Cocanadas 1. This variety of cotton is important in the cotton world on account of its natural colour. Years back the demand for this coloured cotton from Europe was great. In recent times, due to export restrictions and lack of sufficient local demand the price obtained for Cocanadas cotton as compared to other indigenous cottons of similar staple and style was very low. Consequently, this led to a gradual reduction in the area under this variety of cotton. The improvement work on this variety was started as early as 1931 at the Agricultural Research Station, Lam in Guntur and was intensified later under a scheme financed by the Indian Central Cotton Committee in 1941. As per the approved programme, the aim is to evolve a deeper-coloured and better stapled variety from the local unselected bulk as well as by suitable hybridisation. As a result two cultures better than C. 1 in colour and quality were obtained of which one is renamed as C. 2 and is being multiplied for distribution. The other one R. H. 25 is being tested under cultivators' conditions in the districts to find out its suitability for the tracts where Cocanadas cottou is cultivated. But in the meantime, the low demand for this coloured cotton and consequent poor prices obtained in the market has been an indication to revise the policy of breeding by switching over from coloured types to white types since the latter was more paying for the cultivators. With this changed objective suitable hybrid materials are being tested at varying stages for the evolution of a white type suited for different soils and sowing periods.

Along with the improvement of Cocanadas cotton, the improvement of short-stapled Chinnapathi is linked since the co-existence in the same tract of a short-stapled and medium stapled cotton is always an impediment for the maintenance of purity of the improved strains. Hence, improvement of Chinnapathi was sought to be achieved by the evolution of both coloured and white types which were early in duration and possessed a high percentage of ginning. In this connection, several hybrid progenies are under tests for the early sown conditions of the Chinnapathi area. In addition, a few types from the Punjab (I) have been found to be very adaptable to the local conditions. The trial of such cottons is in progress.

5. **Westerns**: This commercial variety of cotton normally occupies an area of 6·3 lakh of acres spread over the districts of Bellary,

Cuddapah and Anantapur. Of this area, at present 91·9% is covered by the improved strain W. 1. Since the year 1949 intensive studies are under way at the Agricultural Research Station, Hagari under the auspices of a Scheme (Westerns improvement Scheme) financed by the Indian Central Cotton Committee to improve (1) the yield of lint per acre obtained at present, (2) evolve drought-resistant starains and (3) minimise wastage in spinning compared to W. 1. Of the several cultures that are in the higher stages of trials, special mention may be made of four cultures namely 2711, 3870, 4272 and 4327. All these possess better fibre properties and a higher ginning percentage than W. 1. Then adaptability to the varying environments in the districts is being tested.

As mentioned earlier in this report, Mungari is a short-stapled trade component of Westerns cotton which is cultivated in the lighter soils of Bellary, Kurnool and Anantapur districts during the early season (June—July) to about December—January. The normal area under this cotton was about a lakh of acres but in recent times, due to competition from groundnut, the area under this variety of cotton has been considerably reduced. This variety is short-stapled and coarse, fit only for spinning yarns of about 10 counts. Since this variety is more or less cultivated interspersed in the westerns area, the scope for adulteration is great. Therefore, improvement work on this variety of cotton was undertaken from the year 1937 with the financial assistance of the Indian Central Cotton Committee in a scheme (Mangari Breeding Scheme) specially sanctioned for the purpose. The venue of work was located at Adoni where suitable light red soils are available for ex-perimental work. As a result of intensive breeding work one strain 881·F now renamed as Rayalaseema 1 has been evolved. This variety though slightly longer in duration is equal to the locals in yield but definitely better in quality, being capable of spinning 28 warp counts as against 10's for local Mungari. This strain is being multiplied for distribution in the Mungari tract. Further efforts to reduce the duration are in progress.

6. **Northerns:** This commercial variety of cotton occupies normally an area of over 1·18 lakh of acres, mainly in the district of Kurnool. Of this area, only 17·9 percent is now sown to the improved strain N. 14 distributed by the Department. Though this strain is one of the best of the indigenous cottons cultivated in the Indian Union and capable of spinning upto 40's standard warp counts, the scope for its spread is very limited on account of its suitability only to soils of lighter nature and to tracts with heavier rainfall. With a view to evolve a more cosmopolitan type of *arboreum* strain suited to the entire Northerns area a scheme for the improvement of Northerns Cotton was inaugurated in June 1949 with the financial assistance of the Indian Central Cotton Committee. Under this scheme, a large number of progenies from interstrain and intra-arboreum crosses has been subjected to trials in various stages. As a result, four cultures have been found to be equal to N. 14 in yield and quality but definitely superior in their ginning percentage to N. 14. The adaptability of these cultures to varying conditions of soil and climate is being tested out in the districts, from which the most promising ones will be multiplied and distributed. In the earlier stages of trial there are three promising cultures

namely 6116, 6234 and 6246. These are being tested for consistency of behaviour.

As a sequel to the evolution of improved strains in the several commercial cottons of this State, extension of their cultivation to benefit the cotton growers has been actively engaging the attention of the Department in maintaining their purity, their multiplication under controlled conditions and distribution of the pure seeds on a large scale. In achieving this objective seed multiplication schemes partly financed by the Indian Central Cotton Committee have been in operation for each of the important cotton strains evolved.

Madras Cambodia Uganda 1 cotton that has been found to be suitable for the Winter sowings also in the Central and Southern districts is being multiplied over an area of about 5,000 acres. It is ultimately proposed to cover with this strain an area of about 4 lakh of acres in the districts of Coimbatore, Salem, Madurai, Ramanathpuram, Tirunelveli and South Arcot. Arrangements have been made to multiply the seeds both at Srivilliputhur during summer and in Coimbatore distrct during winter. The annual production of pure seeds is arranged from an area of about 9,000 acres of seed farms in the two districts. The seeds from this area are being utilised for distribution in the districts of Salem and South Arcot also.

Karunganni strains K. 2 and K. 5 have been found to be useful in the Southern and Central districts respectively and to cater to the needs of about six lakh of acres in these areas the two strains are being multiplied in Tirunelveli and Coimbatore districts respectively over an area of over 40,000 acres of seed farms. It is expected that the seeds procured from these seed farms would be sufficient to cover the entire Karunganni area in the districts. The Westerns area W. 1 has been found to be better than ordinary Westerns and therefore efforts are continued to run 6,000 acres of seed farms in Bellary district. The improved strain is reported to have covered 91·9% of the total area under Westerns cotton. The improved strains of Cocanadas cotton namely C. 1 and C. 2 are being multiplied in an area of about 1,000 acres of seed farms with the object of ultimately covering the entire area under Cocanadas cotton.

B. AGRONOMIC STUDIES

As a result of extensive agronomic experiments the following conclusions and results have been achieved so far:

(1) Under irrigated conditions it was found that earlier sowing of Cambodia cotton resulted in higher yields and relative freedom from insect damage.

(2) Winter-sown irrigated Cambodia cotton required, for optimum growth, irrigation once a fortnight during the earlier stages and more frequently during the critical period of boll formation.

(3) Under irrigated conditions, closer spacing of plants in the row, rows being 2½ feet apart did not result in better yields. The optimum spacing for irrigated cotton was therefore found to be 2½ feet between rows and nine inches between plants in the row.

(4) Planting Cambodia cotton on the sides of ridges tended to establish a more uniform crop than that planted in beds, though there was no significant difference in the yield. However, there was a definite saving in irrigation water when the crop was planted in ridges.

(5) Associated cropping of clusterbeans with summer cholam preceding Cambodia cotton was found to remove the ill-effects of cholam on Cambodia cotton.

(6) Cambodia cotton after a fallow period or a groundnut crop was found to yield better than after a ceral crop like Cholam or Ragi.

(7) In the manurial trials it was found that cotton generally responded to the application of nitrogenous manures. Under irrigated conditions, 60 to 80 lbs. of nitrogen resulted in better yields of cotton, whereas under rainfed conditions in regions where the annual rainfall was more than 25 inches, cotton yields were enhanced by the application of 40 lbs. of nitrogen in the form of either ammonium sulphate or groundnut cake.

(8) In Coimbatore tract a better preparatory cultivation for cotton was found in immediately ploughing the land after harvest of the previous crop of Cholam in order to remove the stubbles.

(9) In the Tinnevelly tract it was found that mixing of indigo with the previous crop of Irungu Cholam tended to increase the yield of cotton succeeding, thereby mitigating the ill-effects ot fodder cholam.

(10) Agronomic experiments to determine the minimum preparatory and after cultivation necessary for cotton under rainfed conditions clearly indicated that deep preparatory cultivation was not necessary and that keeping the land free of weeds was the only after cultivation that was necessary under rainfed conditions.

(11) Experiments on mixed cropping revealed (1) that a legume mixed with a cereal preceding the cotton was better than a cereal alone (2) that cotton can be raised along with groundnut without any appreciable reduction in the yield of groundnut and thereby increasing the gross return per acre for the grower and also increasing the output of cotton in the State (3) similarly experiments proved that cotton along with chillies can be successfully raised in tracts like Guntur and (4) with Ragi in South Arcot and Chingleput districts.

C. FUNDAMENTAL STUDIES

(a) As a necessary adjunct to researches connected with the breeding of improved strains of cotton to suit different soil climatic conditions, to evolve superior qualities suitable for spinning the finer yarns and to isolate strains resistant to pests, diseases and adverse seasonal and environmental conditions, the section has also been devoting attention to the study of fundamental problems connected with the inheritance of economic characters such as lint length, maturity of lint, fineness of lint etc. Such studies have indicated that short lint is monogenic in inheritance, and that immaturity of lint in relation to lint length conforms to a dihybrid ratio. In the studies with lintless types indications have been obtained that the lintless type carries a gene for maturity which finds expression in the presence of the gene for lint. Cleistogamy in cotton is a simple recessive to normal flower opening. In addition to these studies, the inter-relationship that may exist between the several attributes of cotton is also sought to be studied by genetic analysis.

(b) Often in connection with seed multiplication schemes it has been experienced that seeds of one season are left over unsold for the next year. To study if such seeds can be safely utilised for sowing during the next year, storage experiments were instituted on a number of varieties of cotton—indigenous and exotic—the results from which indicated, that viability of seeds could be maintained for over two years at a high level provided conditions of storage were carefully attended to. This experiment, was continued to find out if seeds so

stored for over one year when used to raise a crop would result in the same cropping power as fresh seeds. For this purpose field experiments were conducted simultaneously in all the cotton sub-stations and the results therefrom amply demonstrated that the use of old seeds did not in any way affect the yield levels.

(c) Reports from elsewhere claimed that pre-soaking of cotton seeds in certain chemical solution resulted in enhancement of yield when such treated seeds were sown. This claim was arranged to be confirmed by regular experiments conducted at five different localities covering three exotic types and four indigenous varieties. The results of the experiment indicated that due to pre-treatment of seeds in molar, half-molar and quarter-molar solution of mono-potassium phosphate or ammonium sulphate did not result in increase of yields or any alterations in the seed and lint characters.

(d) Experiments to explore the possibilities of vegetatively propagating cotton, especially hybrids which naturally tended to segregate in subsequent generations, conducted at the Cotton Breeding Station, Coimbatore during two seasons indicated that the treatment of cuttings of cotton stems with Seradix—B. 3 resulted in a high percentage of rooting. The possibility of vegetatively propagating cotton was thus indicated.

(e) In connection with the study of the inheritance of the resistance to Blackarm and jassids, several crosses made between resistant and susceptible types and the hybrids are in various stages of study representing inheritance and the principal factors responsible for the resistance to the diseases and pests respectively.

To sum up the results of various activities of the section, it may be said that improved strains of cotton resulting in extra income per acre to the cultivators has been achieved in the case of all the commercial cottons in the State. Again, further researches in the matter of improving quality have already shown signs of promising results in the evolution of quality cottons which can compare favourably with the imported East African Styles. Apart from these, by fundamental and agronomic studies optimum conditions under which cotton can be grown with advantage have also been evolved. The results of such experiments have already been included as items of propaganda in the districts. The economics of cotton research and extension of the results therefrom, are indicated in terms of money value in the accompanying table, from which it would be seen that due to cotton research and extension, the annual additional income to the Cotton growers is over four crores of rupees.

Value of Cotton Research and Extension Thereof

Zone	Improved seeds	Extra lint (pound) per acre	Additional income per acre	Area covered acres 000's	Estimated extra income for the State (lakh of rupees)
	A. BREEDING				
Central and Southern Districts	Cambodia—2	30	42	42·5	17·9
Southern Districts	Madras Uganda—1	27	55	95·4	52·5
	Madras Uganda—2	27	55	(Released in 1951—1952)	
	Karunganni—2	23	30	217·8	65 3
Central Districts	Karunganni—5	35	40	117·7	47·1
Deccan	Westerns—1	9	9	370·2	33·3
	881. F	—	15	2·7	0·405
	Northerns—14	—	3	20·1	0 6
Circars	Cocanadas—1	12	4	15·9	0·6
					217·705
	B. AGRONOMY				
Central Districts	Time of planting in Winter (Coimbatore)	120	120	2·5	3·0
Carnatic	Time of planting (summer) South Arcot	120	245	1·0	2·4
Central and Southern Districts	Application of Ammonium sulphate	100	100	13·0	13·0
					18·4

Zone	Improved seeds	Extra lint (pound) per acre	Additional income per acre	Area covered acres 000's	Estimated extra income for the State (lakh of rupees)
	C. EXTENSION OF AREA				
	Introduction of cotton in rice fallows (Carnatic)	200	200	1·8	3·6
	Mixed cropping of groundnut and cotton (Circars) Chillie cotton	40	40	34·0	13·6
	Mixed cropping of groundnut and cotton (Deccan)	40	40	6·9	2·8
	Mixed cropping of Ragi, groundnut and cotton (Carnatic)	37	37	2·7	1·0
					21·0
	D. LEGISLATION OF COTTON CONTROL				
Central and Southern Districts of Carnatic	*Certification of exempted cottons:*				
	Madras Uganda—1 (Summer) at Rs. 250/- per bale on 20,000 bales				50·0
	Madras Uganda—1 (Winter) at Rs. 200/- per bale on 50,000 bales				100·0
					150·0
				Total	407·105

Aluminium in Plant Nutrition

By

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The metal aluminium is one of the relatively abundant elements in the earths' crust and as such it is a constituent of almost all soils. Inspite of its abundance, its essentiality for plant growth is still not definite, although its presence has been observed in minute quantities in most plants.

It exists in all flowering plants, in widely varying amounts, from 6 mg. per kgm. of dry matter in sugar beet, upto 1640 mg. per kgm, in beans. Grains and seeds as a rule are very low in Aluminium-content. Green leafy vegetables ordinarily contain the highest proportion of Aluminium. It accumulates more rapidly during early growth than later, more abundantly in the leaves than elsewhere and particularly so in the greenest leaves than in pale or etiolated ones. Fleshy succulent fruits have usually a medium content of Aluminium., but strawberries seem to be an exception as they are relatively rich in this metal. Edible roots have less than ordinary roots. Bulbs and tubers have a medium Aluminium., content, but the onion bulb is especially rich as in other metals.

One curious feature is that *xerophytes* are as rich in Aluminium as *hydropvytes.* Among the *Pteridophytes* in the ferns like *Aspidium* and *Polypodium,* Aluminium deficient plants were found to be more sensitive to frost. In *Lycopodiums* several species are found to behave as Aluminium accumulators as also one or two species of *Euphorbiaceae.* The *Pecan* nut is another accumulator of Aluminium.

Being an amphoteric element, it is not surprising to find that Aluminium in soluble form is found in large amounts in soils that are strongly acidic as well as in strongly alkaline soils.

The first evidence of Aluminium toxicity is dwarfing of the plants and injury to the roots. Plants accumulate Aluminium, in the cortex, mainly in the protoplasm, with a concentration of it in the nuclei.

In the case of rice, toxic symptoms begin to develop in the concentrations of 1/7500 N. and above of Aluminium chloride. In sugarcane, too much Aluminium in the soil is believed to be one of the factors involved in the low fertility of some Hawaiian soils.

Soil phosphates, in concentrations equivalent to that of Aluminium are able to neutralise completely the toxicity of an excess of Aluminium compounds in the soil. Liberal dressings of organic matter are also helpful in counteracting the effects of Aluminium, upon sensitive crops.

One of the most interesting features of Aluminium, nutrition, is its ability to change the colour of flowers from pink into blue. Thus in *Hydrangeas*, pink flowers can be changed to blue by spraying them with a 2·5% solution of aluminium sulphate. When the buds are sprayed repeatedly (five times) with aluminium sulphate, it is possible to secure blooms of uniform blue. The injection of Aluminium, sulphate into the stems of normally pink-flowered *Hydrangea* plants also influences the colour and if a fairly deep cut is made near the base, it is possible to obtain completely blue umbels.

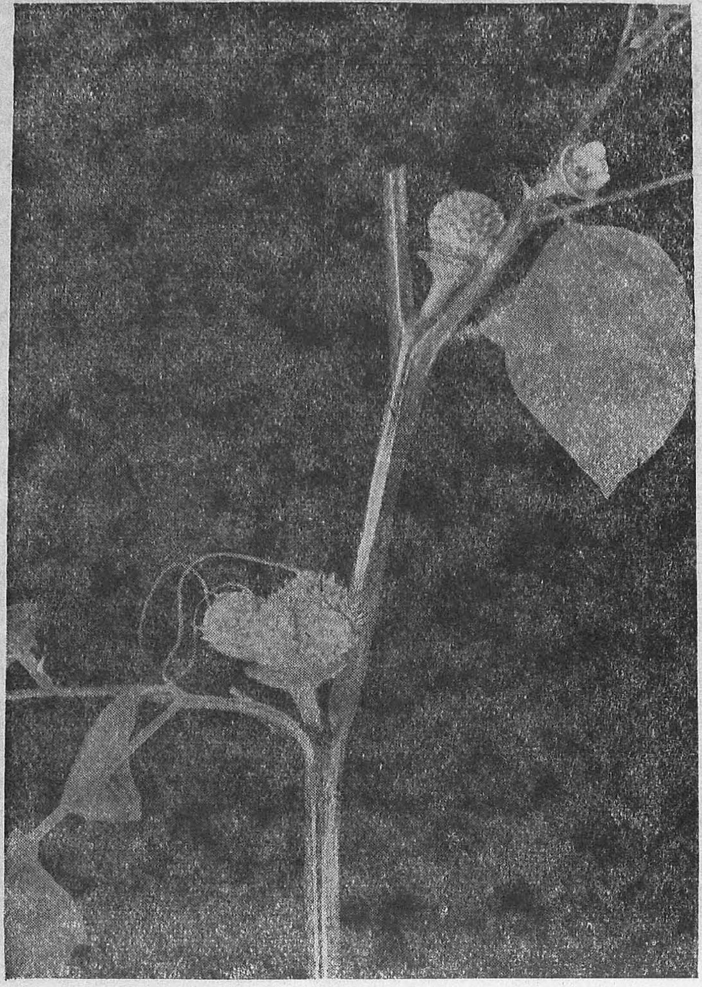
In the cultivation of *Cyperus malaccensis* which is grown in Japan for making nets, application of Aluminium sulphate to the soil had a distinctly favourable effect upon the growth, yield and quality of fibre. Other workers have also reported improved growth in a few other crops by supplying small amounts of Aluminium salts to the soil, but considering the narrow margin that exists between optimum and toxic levels; this is not a practice that can be advocated for general adoption.

Research Note

A Note on Paddy Straw Treatment for Improvement of Feeding Quality

The quality of paddy straw as a feed could be increased in two ways. One by improving its feeding value as assessed by increased calorific value of the straw and the other by reducing the high contents of certain substances like potassium and oxalates which are present in deleteriously high amounts in the paddy straw. Work done at the Veterinary Research Institute, Izatnagar (3) and at the Agricultural Research Institute, Coimbatore (2) had indicated that the quality of straw as a feed could be increased in both the counts mentioned above by the alkali treatment (i.e. straw treated with 8 times its weight of 1·25% alkali). It has recently been indicated (1) that mere water washing of the paddy straw improves its quality as a feed.

In order to get definite data on this point, a small quantity of paddy straw was soaked with 8 times its weight of distilled water and left overnight. It was subsequently washed, dried and taken up for analysis with the original untreated sample.



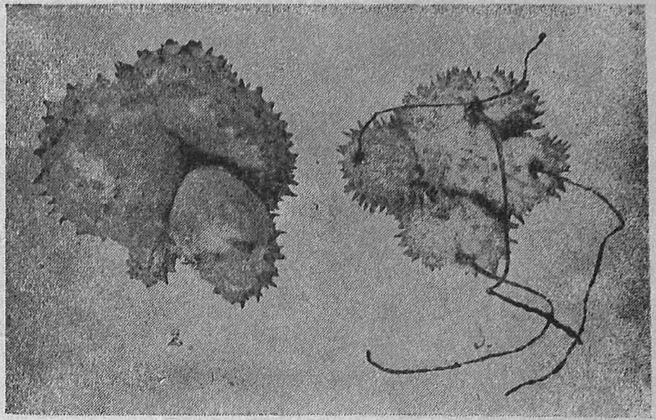
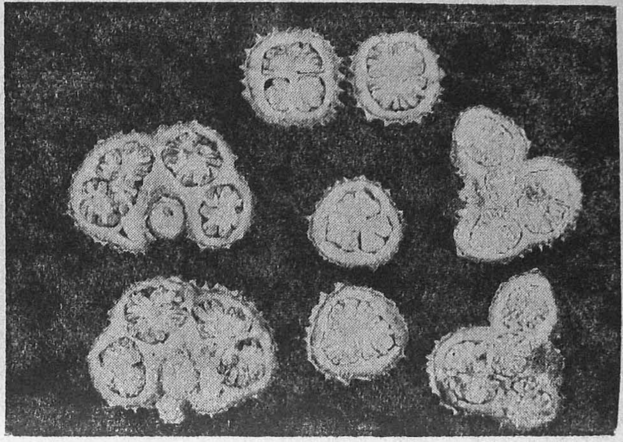


Fig. 2

Fig. 3



The results of analysis are given below:—

Heads of analysis	Before water treatment (%)	After water treatment (%)
Moisture	8·24	28·30
On oven dry basis :		
Minerals	20·52	21·69
Insoluble matter	16·84	19·23
Crude fibre	26·37	26·08
Potash as K_2O	1·53	0·64
Oxalates as oxalic acid	0·895	0·444

From the results of analysis it will be evident that nearly 50% of the potash and oxalates are removed by water washing alone. But there is no tangible change in the contents of minerals and crude fibre. The water washing is not also as effective as alkaline treatment wherein nearly 70% of the harmful oxalates and potash were removed. Its chief advantage lies in its cheapness and easy adoption by every farmer without any technical intricacy.

Agricultural Research Institute,
Lawley Road P. O., Coimbatore
30th November 1953.

A. MARIAKULANDAI.

1. Kehar, N. D., Indian Farming, Vol. 2, p. 14, 1953; 2. Mariakulandai, A., Madras Agricultural Journal, Vol. 35, p. 1, 1948; 3. Sen. K. C. Ray, S. C., and Talapatre, S. K., Indian Journal, Vet. Science and Animal Husbandry, Vol. 12, p. 14, 1942.

Polycarpy in Datura fastuosa Linn.

The fruits of *Datura fastuosa* L. are capsules, generally developed from a syncarpous ovary. The ovary usually carries a single style. One plant developing many abnormal fruits was noticed in the Agricultural Research Institute, Coimbatore. Most of the fruits of this plant were abnormal with varying numbers of partially free carpels, very often with 3 to 5 carpels developing half apocarpously. Each of the carpellary projection carried an individual style. (Fig. 1, 2 and 3). Transverse sections of the fruits also (Fig. 4) bring out this feature clearly. However, the placentation has been found to be very irregular in fruits with more than three carpels.

In plants which have normally a reduced number of carpels as compared with that of the members of the other whorls of the flower, increased number of carpels have been recorded. These cases may be regarded as reversions to a larger number of carpels which probably constituted the original ovary. Five carpels have been recorded (Worsdell 1916 — The Principles of Plant Teratology - Vol. II) in *Linaria vulgaris* and *Spilanthes* and four carpels in *Cleome spinosa* instead of the two characteristic of the orders *Scrophulariaceae*, *Compositae* and

Cruciferae respectively. In the characteristically monocarpic *Leguminosae* and *Rosaceae,* five carpels in *Mimosa* two to three carpels in *Trifolium repens,* two carpels in *Phaseolus multiflorus* and two to five carpels in *Prunus* and *Amygdalus* have been recorded. In *Gingko biloba* and in the double flowers of *Delphinium* an increase in the number of carpels has also been recorded by Worsdell. The bicarpellary condition of *Datura* must be a case of reduction from its original number five, of which all the whorls of the flower once were composed. The increase in the number of carpels upto five in the present case under record can be regarded as a reversion.

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Fimbristylis miliacea Vahl.—A New Host for *Striga euphrasioides* (Vahl.) Benth

Striga is a semi-parasite on roots of other flowering plants. Fortynine species of *Striga* are known. The distribution of this genus appears to be confined to tropical regions of Africa, India, South East Asia, East Indies and Australia (Pearson 1913; Wilson Jones 1953). In India, six species of *Striga* have been reported to occur (Hooker 1885; Gamble 1228; Santapau 1950). Of these, *S. asiatica* (L.) Kuntze (*S. lutea* Lour.) and *S. euphrasioides* (Vahl.) Benth. are very common. Both these species enjoy a very wide range of host plants. Kumar and Solomon (1941) have given a detailed host list for four species of *Striga* occurring in India. According to these authors, *S. euphrasioides* has been found to parasitise members of *Cyperaceae, Gramineae, Polygalaceae* and *Rubiaceae.*

Recently *S. euphrasioides* was found parasitising *Fimbristylis miliacea* Vahl. (Cyperaceae), a common sedge of the rice fields, in the wetland area of the Central Farm, Coimbatore. The roots of *S. euphrasioides* were found to be attached to those of *Fimbristylis miliacea* by means of lateral haustoria. This species has not so far been recorded as a host for *S. euphrasioides* or for any other species of *Striga* known to occur in India.

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Mycology Section, Agric. Coll. & Res. Inst. Coimbatore: 5th January 1954.

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C. L. SUBRAMANIAN.

EXTRACTS AND GLEANINGS

Mechanical Cultivation and Harvesting of Wet Paddy in Malaya: Emphasis has been laid on investigations within the 'hard pan' zones of the coastal alluvial clays derived from mangrove swamps where cultivation is mainly carried out by a short chipping scythe. In reference to soils water relationships four possibilities were laid viz., (i) dry cultivation followed by drilling or seeding in dry soil with subsequent irrigation, (ii) dry cultivation by flooding and transplanting as usual, (iii) wet cultivation followed by transplanting and (iv) dry cultivation followed by flooding and seeding in shallow water. No. 3 gave higher yields. On the so called "bottomless" soils only dry cultivation is possible and success depends on the use of low bearing pressure tractors, since these soils have high water table in the cultivation season and cultivation becomes progressively difficult after the completion of the first cultivation. For this reason an implement such as a tractor mounted or tractor-drawn rotary hoe which produces tilth in one operation is advantageous.

Preparation of Paddy Land: In the hard pan soils since deep cultivation has been shown to offer no advantages over shallow cultivation the ideal implement for the first two operations has usually been a mounted mould board plough with semi digging bodies. After-cultivation with the soil wet is best carried out by a double or triple notch pole of a weight and size suited to the particular tractors. Several adoptions for wheeled tractors such as a wide gauge tractor, fitting standard wheeled tracks by using large-size rear wheels or out-size 'rice' types on standard size wheels etc. are described.

Seedling or Planting: Not much progress done. Only limited attention has been paid. The old fashioned 'fiddle' type of hand broad caster of germinated seedlings has given useful results. Anyway for the present a nursery has to be maintained to transplant in case broadcasting fails. Whenever broadcasting by fiddle succeeds on a small scale so also will broadcasting from aircraft succeed on a larger scale. This also helps solve problems of weed control and fertiliser top dressing.

Weeding the Growing Crop: Methods like (i) preplanting cultivation, (ii) offseason cultivation with dry land crops, (iii) complete water control, (iv) use of selective herbicides were tried. The third method was ideal but not against swamp weeds in a broadcast crop but was efficient in a transplant field. The fourth method with 2–4 D, M. C. P. a commercial dust based on hormones were tried using a portable engine-driven knapsack duster. Dusts were found less effective than sprays and neither was effective against sedges and many swamp grasses. Use of aircraft for spraying weedicides (American method) were tried but the danger of drift to other crops is excessive. So it can be used only to areas where no other crop is grown.

Application of Fertilizers: Where fertilizers give a response in yield, the phosphorus and potassium fertilizers are best applied before planting or before final cultivation whereas most of the nitrogen is best applied as a top-dressing either broad casting or placement in wet soil. The first can be mechanized using standard manure distributors but nitrogen top dressing will have to be done by hand. Application in pellet form from air is possible but is unlikely to be economical.

Irrigation Control: The ability to withdraw water or to put it on the land at will is normally considered essential for mechanised cultivation. The difficulties with Malayan soils and conditions are mentioned. "On most bottomless soils

areas the clays and bog soils are so permeable that localized water control is much more limited. This physical character of old mangrove soils require some emphasis as it is not generally realized that irrigation water during the growing season forms a continuous phase downwards into the soil and that the whole land surface may move up and down with the flow and ebb of tides. Under such conditions it would be unreasonable to expect the degree of water control that obtains on inland soils with a puddled pan."

Harvesting Operations: Mechanization at present forms a serious obstacle until its associated problems are approaching solution especially, in under-populated areas. The peak labour requirements arise mostly owing to uniform planting and the sudden onset of dry weather lead to such uniformity of ripening that any delay in reaping results in losses from shedding. The conventional method is similar to that in South India.

Mechanisation of either cutting or threshing would greatly ease the peak labour requirements at harvest and that when full mechanization is not required it will be wasteful to use a combine harvester. For machanised harvest the type of paddy grown should ripen uniformly, not shatter too easily, have stiff stout straw, and not liable to lodge. Trials with conventional cutter bars showed cutting was easy but later considerable labour was required to arrange the tangled swathe in sheaves for normal threshing. With reaper binder it was found that when dead ripe considerable shattering occurred and when cut early heating when stooked, sun-cracking etc. took place. A prototype header gave some promise of success. With combines the problem has been flotation, the wheels sinking into the bog upto the chassis and increasing draught. When a large-scale farm is laid specially for mechanised paddy cultivation the type of selfpropelling combine harvester which has given results elsewhere in South East Asia may prove successful. Several other threshers like Tullos thresher, Robinson, Midget thresher, Turner Economy thresher were used and showed lowering of labour requirements. (A review of investigations into the mechanical cultivation and harvesting of wet paddy with special reference to the latter. Alleen E. F. and D. W. H. Hayees. Malayan Agricultural Journal. vol. 2. 1953; 161—180). N. K. S.

Weather Review — For the month of December 1953.

RAINFALL DATA

Division	Station	Total rainfall for the month in inches.	Departure from normal in inches	Total since 1st January in inches
Orissa & Circars	Gopalpur	..	—0·5	50·0
	Calingapatnam	..	—0·5	45·2
	Visakhapatnam	..	—0·6	34·4
	Arakuvalley*	0·0	—1·0	47·3
	Anakapalle*	..	..	..
	Samalkot*	..	..	..
	Kakinada	..	—0·7	40·7
	Maruteru*	..	..	..
	Masulipatnam	..	—0·7	39·6
	Guntur*	..	..	..
	Agrl. College, Bapatla*	..	—1·5	31·1
	Agrl. College, Farm, Bapatla*	..	—0·5	24·7
	Rentachintala	..	—0·1	32·6
Ceded Districts	Kurnool	..	—0·2	33·5
	Nandyal*	..	..	..
	Cuddapah	..	—0·8	19·5
	Kodur*	..	..	..
	Anantapur	..	—0·3	34·1
Carnatic	Nellore	..	—2·9	28·3
	Buchireddipalem*	0·2	—2·8	28·4
	Madras (Meenambakkam)	1·5	—4·0	37·6
	Tirurkuppam*	0·4	—5·4	37·7
	Palur*	1·7	—4·8	39·3
	Tindivanam*	1·1	—3·1	31·5
	Cuddalore	2·8	—4·7	41·6
Central	Arogyavaram (Chittoor dt.)	0·1	—0·9	34·1
	Vellore	0·5	— 2·1	30·4
	Gudiyatham*	0·3	— 2·4	26·9
	Salem	0·1	— 0·9	51·2
Central Contd.	Coimbatore (A. M. O.)*	0·8	— 0·6	32·4
	Coimbatore	0·1	— 1·3	30·8
	Tiruchirappalli	0·3	— 2·3	41·4
South	Nagapattinam	5·7	— 5·3	39·7
	Aduturai*	1·9	— 2·1	27·7
	Pattukottai*	3·3	— 0·5	37·8
	Madurai	0·4	— 1·6	45·5
	Pamban	3·3	— 4·3	31·9
	Koilpatti*	0·4	— 1·7	26·1
	Palayamcottai	0·6	— 3·6	27·4
	Ambasamudram*	4·3	— 1·7	40·1
West Coast	Trivandrum	1·5	— 1·0	75·5
	Fort Cochin	0·9	— 0·7	112·7
	Kozhikode	..	— 1·5	98·0
	Pattambi*	..	— 1·3	80·5
	Taliparamba*	..	— 1·4	104·8
	Wynaad*	Tr	— 0·8	87·8
	Nileshwar*	..	— 0·7	126·2
	Pilicode*	..	— 1·0	113·3
	Mangalore	..	— 0·7	113·9
	Kankanady*	..	— 0·6	118·0
Mysore & Coorg	Chitaldrug	..	— 0·5	20·1
	Bangalore	..	— 0·4	47·3
	Mysore	..	— 0·4	37·4
	Hagari	..	..	..
	Siruguppa	..	..	..
	Bellary	..	— 0·1	28·1
	Mercara	..	— 0·7	128·2
Hills	Kodaikanal	3·2	— 2·0	64·7
	Coonoor*	1·8	— 5·3	60·3
	Ootacamund*	Tr	— 2·3	60·5
	Nanjanad*	0·1	— 1·5	73·6

Note:— 1. * Meteorological Stations of the Madras and Andhra Agricultural Departments.

2. Average of eight years' data for Arakuvalley is given as normal.

3. Tr = 1 to 4 cents of rain-fall.

Weather Review for December 1953

A low pressure area lay over the South Bay of Bengal on 4-12-1953 but became less marked on the very next day and moved away westwards across the extreme South-west Bay. Dry weather prevailed over the region from 2-12-1953 to 10-12-1953. A low pressure wave moved westwards across the extreme south-west Bay of Bengal on 9-12-1953 and passed away across the Comorin Maldives area on 12-12-1953. This was replaced by another low pressure wave over the extreme South-west Bay on 13—12—1953, which moved away westwards across the Comorin-Maldives area on 16—12—1953. Under the influence of the two waves rainfall occurred at a few stations in the Tamil Nad from 11—12—1953 to 16—12—1953, with a few heavy falls in South Tamil Nad.

A fresh low pressure wave moved westwards across the Sout-west Bay on 17—12—1953. and over the Comorin area on the next day. Two other low pressure waves passed over the same area on the 21st and 23rd December 1953. Yet a spell of dry weather prevailed over the Region from 17—12—1953 to 24—12—1953.

Another low pressure wave was moving across the Ceylon - Comorin area from 24—12—1953 and finally passed away westwards across the Maldives area on 28—12—1953. Under its infiuence rainfall occurred at a number of places in Tamil Nad during the period 25—12—1953 to 28—12—1953.

A low pressure wave was moving westwards across the extreme South Andaman Sea on the last day of the month.

A series of five western disturbances passed across the extreme North of India during this month.

The noteworthy rainfall and the Zonal rainfall for the month are furnished hereunder.

Date	Name of place	Rainfall for past 24 hrs.
14—12—1953	Pamban	2·1"

Zonal rainfall for the month

S. No.	Name of Zone	Average rainfall for the month in inches	Departure from normal	Remarks
1.	Orissa & Circars	0·00	— 0 64	Below normal
2.	Ceded Districts	0·00	— 0 35	,,
3.	Carnatic	1 10	— 3·96	Far below normal
4.	Central	0·31	— 1·50	,,
5.	South	2·49	— 2·60	,,
6.	West Coast	0·24	— 0 97	Below normal
7.	Mysore & Coorg	0 00	— 0 50	,,
8.	Hills	1·28	— 2·78	Far below normal

Agricultural Meteorology Section,
Lawley Road P. O., Coimbatore,
13—1—1954.

C. B. M. & M. V. J.

Departmental Notifications

Gazetted Service — Posting and Transfers

Madras State: Gomathinayagam Pillai, V., on leave, Millets Specialist, Coimbatore; Kacheppeswarn, S. S., Special D. D. Madras, D. D. Vellore; Mohamed Ali, A., Special D. D. Crop Sampling Madras, Senior D. A. O. Crop Sampling Madras; Natesa Iyer, K. V., D. A. O. Madurai, Secretary, South Arcot Market Committee, Cuddalore; Santhanam, K., Additional D. A. O. Trichy, D. A. O. Madurai; Uthaman, P., on leave, S. D. O. Vellore; Umapathy, M., Assistant Engineer, Teacher Work shop, Coimbatore, Assistant Engineer, (Inspection) Madurai.

Upper Subordinates

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TO LET

The Madras Agricultural Journal

Vol. XLI February 1954 No. 2

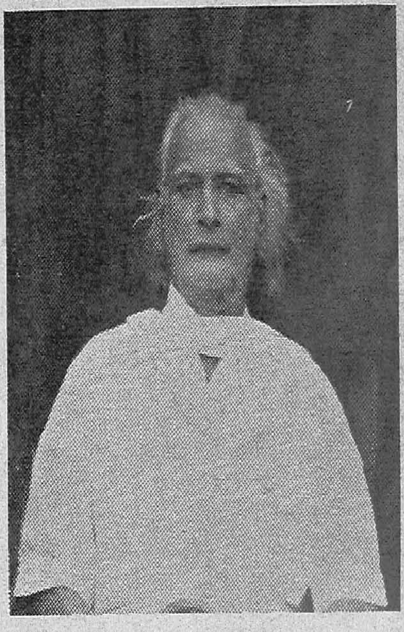
Editorial

One of the important problems that has attracted the keen interest of investigators from very early times is the question of dormancy in plants. 'Dormancy' in *sen sulato* is applied to cases where a tissue that can develop or elongate does not do so. In this sense it has been found in a number of plants, from herbaceous to woody ones. This character has been taken advantage of in plant propagation and in horticulture, especially in the temperate climates. In tropics the climatic conditions are very favourable for a continued growth, yet there are plants which show the character of dormancy in these climates also. Apart from its theoretical interest its importance in commercial production and the problem of its control have been attracting much attention recently. Dormancy can be imposed artificially by environmental conditions but reverts to the normal when such conditions are removed. It can be internal to the plant (not affected by the environment) induced by the lack of certain substances reaching the apex and thus inhibiting growth or it can be confined to the growing point itself. The problem has two contradictory aspects in practical application viz., in some of imposing and in others breaking of dormancy. In tropical climates it becomes more significant in the cultivation of temperate and subtemperate plants such as grapes, apples, citrus etc. In these plants the question is one of enforcing dormancy to restrict the number of flushes and prevent exhaustion of plants. In some cereals as in paddy, continued rainfall during harvest period as in the West Coast causes the mature grains to germinate in the ear. A similar problem is found in groundnut also. Here again inducing dormancy becomes a necessity. The characteristic behaviour of mangoes and similar tropical fruit plants is well known. One would like to have a uniform crop each year than have over-abundance of it every alternate year or so. Here it is a question of control of dormancy and inducing or breaking it at required times. Smudging or smoking has been used in Philippines to force the buds of mango

to open, while it has been used to defoliate and thus induce flowering in jasmines in India. In Nilgiris the problem has been to break dormancy in potatoes and this has been achieved by treatment of the seed with carbon-disulphide. Thus the subject becomes complex and many-sided.

The problem therefore, has been tackled from various angles and has been the subject of much controversy. Several theories have been put forward such as gene control, nutrtional control, proportion of sugars present and the consequent rise in rate of respiration, concentration of certain inhibitory substances in stem apices, photoperiodism and more recent the action of growth-promoting substances etc. Which of these are primarily responsible or whether it is a combined effect of some of them and how far they can be made to act on the plants and produce the desired changes independent of season are important questions awaiting detailed study.

The Andhra Agricultural Journal: The first issue of this bi-monthly journal of the Andhra Agricultural Union containing short reviews of previous work and work to be tackled in the new State in the several agricultural activities has been published with a neat and attractive get-up. It is to be congratulated that the general public has also evinced interest in the starting of the journal by rendering financial assistance. The journal intends to publish articles of scientific also of general interest in agriculture. It is a welcome one since in India there is an insufficiency of such media, for publishing of scientific work and it is hoped that this new journal will come up to the exacting standards of scientific periodicals.



The Late
Rao Bahadur S. Sundararamier

Assessment of Soil Fertility Level — I.
Rapid Tests for available Phosphorus

by

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Introduction: This study was undertaken with a view to obtain a quick assessment of plant nutrients in the soil by some of the well-known rapid methods and thus reduce the time involved in analysis of these nutrients by the routine time-consuming methods now in vogue in this laboratory. Phosphorus, representing as it does one of the "big three" in plant nutrients was first taken up for estimation by these rapid methods.

Phosphorus in soils is the key to our fertility problems and plays a major role in the physiology of the plant. The phosphorus that is of importance to plant nutrition is not the net total phosphorus present in the soil but it is the phosphorus which is soluble and easily accessible to plant roots, herein called "available phosphorus". From time immemorial, agricultural chemists have tried to devise ways and means of assessing this fraction of the phosphorus present in soils. Consequently many methods based on empirical presumptions were evolved. These methods put forth certain soil extractants of different compounds and of different pH according to the tentative assumptions made by the author of the method to simulate conditions prevailing at the root zone of the plant in nature. The time-consuming routine method so far used in this laboratory is the Dyer's 1% citric acid method (7). In this method 1% citric acid in the proportion of 1 : 10 soil to extractant was adjudged to simulate the extraction of P_2O_5 at the root zone of the plant. In the five rapid methods studied in the present work other extractants to simulate root absorption were employed as detailed under "Materials and Methods" below. In the Dyer's citric acid method the period of extraction was for 12 hours and the subsequent evaporation and ignition to destroy citric acid and remove silica by dehydratihg it were all very laborious and time-consuming. The rapid methods cut short the period of extraction and could be utilised for colorimetric estimation of P_2O_5 by Truog's method (2,6).

The comparison of methods of assessing the "available phosphorus" in soils was done in three stages. Experiment I was a straight comparison of the values obtained by the different

methods in the well-known soil types of the Madras State. Experiment II was to assess the presence or absence of interfering ions in colour development in the soil extracts obtained by the different methods and Experiment III was designed to obtain a correlation of the estimates made by the different methods with actual grain yield of the crop grown on the soils.

Materials and Methods. I. *Method of extraction:* Of the methods available in literature, the following five methods were taken up for study:—

Name of method	Extractant	Duration of extraction	Ratio of soil to extractant
1. Morgan's method (1)	Sodium acetate and acetic acid pH 4·8	2 hours	1:40 (2·5 g. to 100 ml.)
2. Truog's method (2)	0.002N. H_2SO_4 buffered with $(NH_4)_2SO_4$ to pH 3	30 minutes	1:200 (1 g. to 200 ml.)
3. William's method (3)	N/2 acetic acid pH 3	2 hours	1:40 (2·5 g. to 100 ml.)
4. Burriel's method (4)	Acetic acid $\div H_2SO_4 +$ $CaCO_3 + MgCO_3$. pH 3·25	5 minutes	1:100 (1 g. to 100 ml.)
5. Olsen's method (5)	0·5 Molar $NaHCO_3$ adjusted *to pH 8·5 with NaOH*	30 minutes	1:20 (5 g. to 100 ml.)

These five rapid methods were compared with Dyer's 1% citric acid method.

II. *Method of estimation:* The P_2O_5 in the extracts obtained by the various rapid methods listed above were estimated colorimetrically by the Truog and Meyer method (6) using a Spekker Absorptiometer for measuring the colour developed with 4·0 ml. of ammonium molybdate sulphuric acid solution and 0·8 ml. of freshly prepared 1% stannous chloride in a suitable aliquot of the extract, made up to 100 ml. In the Dyer's 1% citric acid method alone the usual volumetric method of estimating P_2O_5 was followed.

Materials: The following surface soils representing typical soil types of the Madras State were utilised for the comparison of the various techniques:

Type		No. of samples	Sample No. and location
1. Black soils	...	3	2791, 2793. 2795/'52–'53 Siruguppa
2. Alluvial soil	...	3	S. S. 543, 546, 542/'51–'52 Punavasal, Tanjore dt.
3. Laterite soil	...	3	1374, 1380, 1408/'52–'53 Pattambi.
4. Red soil	...	10	261 to 270/'53–'54 Coimbatore.
5. Calcareous red soil		10	910 to 919/'52–'53 ,,

Experiment I: Comparison of estimates of available phosphorus:—

Procedure: The above soil samples were analysed for "available phosphorus" by the five rapid methods and the Dyer's 1% citric acid method.

Results: The results are presented in table I. From the results obtained it will be seen that no one rapid method can be recommended universally for all types of soils. A comparison of the values obtained by the different rapid methods with those of Dyer's shows, that while in the case of red and alluvial soils the latter method always gives higher values than the former, in the case of black and laterite soils Dyer's values are lower than those obtained by rapid methods. Considering the unsuitability of a universal application of Dyers' 1% citric acid method to all types of soils, the criterion of maximum extraction was found to be more helpful in fixing the best rapid method for a particular type of soil and has also enabled us to bring the various soil types under two broad groups viz. calcareous and non-calcareous. For calcareous red and black soils, William's N/2 acetic acid method at pH 3·0 or Morgan's N/2 acetic acid at pH 4·8 and for non-calcareous red soils, laterite soils and alluvial soils, Truog's 0·002 N. H_2SO_4, seem to be the best rapid methods of extraction of available P_2O_5.

Experiment II. Recovery of added phosphorus in soil extracts:—

Procedure: With a view to see that no interfering ions were present in the soil extracts obtained by the five rapid methods, known amounts of phosphate solution were added to the soil extract and the estimation done as before with the Spekker Absorptiometer.

Results: The results of analysis are presented in Table II. From the data presented therein, it will be clear, that in no case was there any interfering ion, which would mar or enhance the colour development in the colorimetric estimation of the soil extracts obtained by the rapid methods, as nearly 90 to 100% of the added phosphorus were estimated by the colorimetric method.

Experiment III: Rapid estimates of available phosphorus correlated with grain yield:—

Procedure: All the methods tested in this study were based on tentative assumptions which according to the author of the technique was said to simulate the natural conditions at the root zone. So, this experiment was initiated to compare the values obtained by the various rapid methods with the soils of the old and

new permanent manurial plots at the Central Farm, Coimbatore. The fertility status of these soils was known definitely, having the same type of manurial treatment for more than two decades. The average grain yield from the last five crop seasons were computed.

Results: These grain yields with the "available P_2O_5" estimated by the different methods are presented in Table III and the same brought out graphically in plates 1 and 2. From the data it will be clear, that in the case of red soils as in the old and new permanent manurials, the rapid methods of estimating available P_2O_5 except that of Olsen's (5) reflect the fertility status of the soil.

Summary and conclusions: 1. This study was undertaken to try out some of the rapid methods of estimating "Available Phosphorus" in soils.

2. From the first stage of the study detailed under Experiment I, it was seen that there is no one rapid method capable of adoption for all types of soil. The N/2 acetic acid method either of Williams at pH 4·8 or of Morgan's at pH 4·8 was good for calcareous soils and the Truog's 0·002 NH_2SO_4 method was suitable for non-calcareous soils.

3. All the soil extracts obtained by the different methods were studied for the presence or absence of interfering ions in colour development in the colorimetric estimation. As 90 to 100% of the added phosphates were recovered in the colorimetric estimation it was concluded that the soil extracts obtained by the different methods did not have anything which would interfere with the colorimetric estimation.

4. In the case of red soils, a comparison of the estimates of the available phosphorus with actual grain yield of the crops raised on the soil was made and was found to agree closely in four out of the five rapid methods studied.

Acknowledgment: The authors are thankful to the Government Agricultural Chemist for all facilities and guidance given in the pursuit of this study.

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PLATE I

GRAIN YIELDS OF O.P.M. COMPARED WITH ESTIMATED AVAILABLE P_2O_5

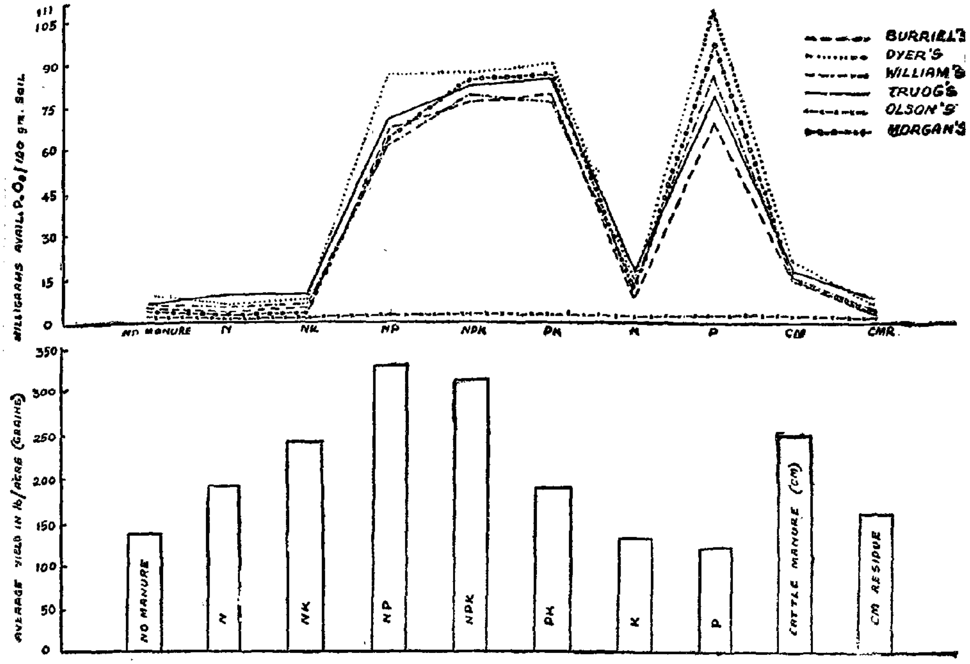

PLATE II

GRAIN YIELD OF N.P.M. COMPARED WITH ESTIMATED AVAILABLE P_2O_5

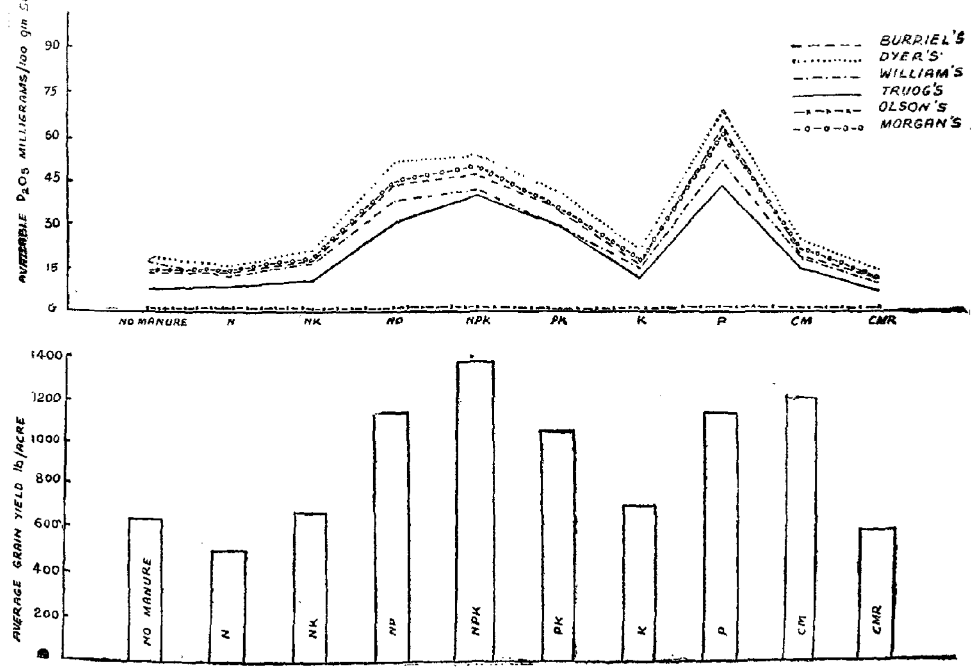

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TABLE I

Showing the available P_2O_5 in different soil types as estimated by different rapid methods and Dyer's method

(Milligrams P_2O_5/100 gram air dry soil)

S. No.	Lab. No.		Truog's method	William's method	Burriel's method	Morgan's method	Olsen's method	Dyer's method
	Black soil from Siruguppa :							
1	2791/52–53	..	3·2	9·0	6·3	6·2	0·8	3·4
2	2793/52–53	..	2·8	9·5	6·5	6·6	0·9	3·5
3	2795/52–53	..	3·0	9·1	6·6	5·0	1·3	5·4
	Alluvial soils of Tanjore deta :							
1	543/51–52	..	2·0	0·6	0·55	1·2	0·8	3·3
2	546/51–52	..	1·7	Nil	0·55	0·8	0·8	3·5
3	549/51–52	..	1·5	Nil	0·20	0·8	0·4	1·2
	Laterite soils from Pattambi :							
1	1374/52–53	..	5·6	0·6	2·3	2·4	5·6	1·8
2	1380/52–53	..	4·0	0·5	1·3	2·0	3·3	2·3
3	1408/52–53	..	2·8	0·5	0·75	1·2	2·3	4·9
	Red soils from Coimbatore :							
1	261/53–54	..	5·4	5·4	4·6	4·6	0·6	9·3
2	262/ ,,	..	7·3	4·4	4·0	3·4	0·2	6·4
3	263/ ,,	..	8·4	4·8	5·3	4·2	0·6	7·9
1	913/52–53	..	8·0	16·5	14·5	14·6	0·7	18·4
2	911/ ,,	..	9·2	11·9	12·7	12·8	0·7	16·7
3	912/ ,,	..	11·1	16·5	16·5	17·6	0·7	20·8

TABLE II.

Showing the percentage of Recovery of Phosphate added to the Soil Extracts obtained using Different Extractants.

S. No.	Lab. No.	Truog's		William's		Burriel's		Morgan's		Olsen's	
			Average		Average		Average		Average		Average
1.	Red Soil O. P. M. 263/54-'54.	98·8	99·4	95·5	97·8	96·7	92·7	100·0	100·0	78 9	90·4
2.	do. 278/ „	100·0		100·0		88·7		100·0		101·8	
3.	do. N. P. M. 912/52-'53.	100 0	100 0	97 0	97·05	95·4	95·55	94·3	94·1	93·2	94·0
4.	do. „ 917/53-'50.	100·0		97 1		95·9		93·9		94·7	
5.	Black Soil, Siruguppa	93·6	96·8	100 0	100·0	99·2	98·6	95·2	95·05	100·0	92·7
6.	do. Anuppapatti	100·0		100 0		98·0		94·9		85·4	
7.	Laterite Soil, Pattambi	90·5	95·25	82·8	85·4	85·1	93·4	91·8	93·8	93·6	93·2
8.	do. „	100·0		88·0		101·6		95·7		92·8	
9.	Delta Soil, Punavasal	93·0	96·15	88·9	94·1	87 2	98.8	87·5	92·85	100·0	94·9
10.	do. Mayavaram	99·3		99·3		96·4		98·2		89·8	

TABLE III

Showing the average grain yields in the old and new permanen manurials as compared with the available P_2O_5 in the soil estimated by different methods

	Available P_2O_5 Milligrams/100 gm. soil						Average yield of grain lb/acre	Remarks
	Truog's	William's	Burriels	Morgan's	Olsen's	Dyer's		
Old Permanent Manurial Soils:								
Lab. No. 261/53-54.	5·4	5·4	4·6	4·6	0·6	9·3	140·5	Unirrigated
,, 262 ,,	7 3	4·4	4 0	3·4	0·2	6 4	190 9	
,, 263 ,,	8·4	4 8	5·3	4·2	0·6	7·9	238 3	
,, 264 ,,	70·0	60 6	63·5	62 0	2·0	83 3	332·2	
,, 265 ,,	80·3	77 0	73 5	77·5	1·8	85·3	308·1	
,, 266 ,,	84·3	76·0	78·5	78·5	2·8	89·5	186 5	
,, 267 ,,	17 3	10·7	9·9	10·2	0·7	14·1	133·4	
,, 268 ,,	84·0	91·2	78·5	94·5	2·8	106·8	128·0	
,, 269 ,,	19·0	16·0	15·4	16·2	1·1	21·0	251·4	
,, 270 ,,	8·0	4·4	4·9	4·2	0·6	7·4	160·2	
New Permanent Manurial Soils:								
Lab. No. 910/51-52.	8·0	16·5	14·5	14·6	0·7	18·4	639 6	Irrigated
,, 911 ,,	9·2	11·9	12·3	12·8	0·7	16·7	513·2	
,, 912 ,,	11·1	16·5	16·5	17·6	0·7	20·8	672·2	
,, 913 ,,	31·0	38·0	43·0	43·5	1·5	52 0	1,158·8	
,, 914 ,,	41·0	42·0	47 0	50·0	1·5	53·0	1,395·6	
,, 915 ,,	30 0	30·0	36·0	35·0	1·3	43·0	1,071·4	
,, 916 ,,	13·2	16 0	15 7	16·2	0·7	20·9	692·6	
,, 917 ,,	43 0	52·0	62·5	60·0	1·9	68·8	1,148·2	
,, 918 ,,	14·8	19 0	18·9	20·8	1·3	24·6	1,210·2	
,, 919 ,,	8·6	10 0	10·7	10·8	0·7	14·7	548·6	

ERRATUM

Vol. XL, No. 12 1953 P. 550. para 2. line 10 from above for 4% DNOC read 40% DNOC.

A Preliminary Investigation on the Preparation of Vegetable Milk from Oilseeds and Pulses

by

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Introduction: Milk prepared from vegetable sources, chiefly the soya bean, has been in use in China, Japan. Korea and other Eastern countries from very early times Children are fed on this milk substitute, and medical opinion in China is in favour of soya bean milk as a valuable substitute for natural milk in promoting growth and development. Bowdidge in his book on the "Soya bean" describes its effect on western palates as "nauseating to say the least". Different methods have been evolved in these countries for the preparation of soya bean milk, mainly consisting of washing the beans three times in water, soaking in water for 12 to 24 hours, heating to boiling point, grinding in a mortar and straining through a bag made of linen.

In the West there had been only sporadic attempts at investigation into the manufacture of milk substitutes, the probable reason being the availability of natural milk in abundance. During the World War I a synthetic vegetable milk was put on the market under the name "Lehman's Vegetable Milk". This was prepared out of beans like the soya and almond. The milk had a thick consistency, brown colour and a pleasant aroma. It had a composition of 7 per cent vegetable protein, 25 per cent fat, and 42 per cent sugar. One teaspoon of this vegetable milk with a pound of ordinary milk and a pound of water made a nourishing mixture, rich in fat and sugar though poor in protein. But this preparation had a farinaceous taste.

In recent times refined methods have been adopted for the preparation of milk substitutes. The details of processing are as follow. Ground beans are moistened, allowed to stand for 8 hours, treated with steam to deodarise and emulsified by triturating with water and pressing out the milk. The emulsion is again boiled for 5 minutes, treated with salt, glucose and soya bean oil, vanilla or almond extract added, agitated in a shaking apparatus and sterilised. Refined fat is also sometimes incorporated by emulsification at 60°C. In another process the seeds are germinated and ground with whey, water or skim milk, the pulp heated and fermented with enzymes to break down the proteins and carbohydrates, emulsified with vitamin-containing substances, homogenised

and dried by atomising in hot gases. The product is reported to be useful in rearing calves.

The practice of adding coconut 'milk' (prepared by kneading the scraped kernels with small quantities of water and pressing through cloth) to certain preparations is well known on the West Coast. The poorer classes sometimes use it with coffee as a substitute for milk. Cotton seed milk is known to be useful to nursing mothers for increasing milk secretion.

The purpose of the present studies was to see if milk can be prepared economically from oilseeds or pulses other than soyabeans and the quality of such preparations.

Materials and Methods: Trials were made in the laboratory on the preparation of vegetable milk from pulses and oilseeds. The pulses tried were horsegram, bengalgram and lablab, and among the oilseeds groundnut, cotton-seed and coconut were used. The pulses were soaked in water for over 8 hours after thorough cleaning and then ground into a paste, emulsified with water, filtered through muslin, the filtrate boiled a short while and again passed through muslin. A similar procedure was adopted for cotton-seed also, but groundnut and coconut kernels were crushed without previous soaking and the milk extracted by squeezing through cloth. The milks were then tested for their palatability by distributing them to different persons both as milk and added to coffee and tea.

Experiments were also conducted with a view to effect improvements in the quality of these milks and to get rid of their characteristic unpleasant flavours, by grinding the seeds to flour, adding water in sufficient quantities, boiling and pressing through muslin. The milk obtained was of the same quality as that obtained by the process described earlier. In the case of horsegram and bengalgram milk the flour was made into a paste with water and allowed to stand for several hours after which steam was passed for 15 minutes. More water was then added and the mixture triturated, filtered through muslin and boiled.

Discussion: The colour, consistency, flavour and other properties of these milks and their chemical composition are given in Tables I and II. It will be seen that cotton-seed milk approaches cow's milk in nutritive value. Groundnut and coconut milk have high fat content, but the latter is poor in proteins. The milk from pulses have a lower fat content than cow's milk, but could be made up

to approximate to the composition of cow's milk by the incorporation of suitable quantities of fat.

The products from pulses had the characteristic flavour of the respective grains which could not be masked even by the addition of flavouring agents like vanilla essence. The remarks made about soya bean milk may be said to apply in a greater degree to these milks. Tasters were unanimous in their verdict that these milk substitutes were repulsive either alone or added to tea and coffee. Coconut milk and cotton-seed milk were not objectionable when mixed with coffee, but taken alone they had a characteristic taste which could not be described as unpleasant. The high fat content of coconut milk and its proportionately low protein value might lower its usefulness as a milk substitute. The product from cotton-seed alone appears to deserve further investigation by nutrition experts in regard to its digestibility and toxicity, if any. The attempts to remove the odour from horsegram and bengalgram by modified techniques resulted in products which were worse than those of milk prepared by other processes.

Conclusions: Attempts were made to prepare vegetable milk from some pulses, groundnut, coconut and cotton seed. The preliminary studies show that milk prepared from vegetable sources is not likely to replace or supplement cow's milk in the dietary of the people of this country. Elaborate investigations will be required in the direction of deodourising the raw products and assessing the digestibility and growth-promoting properties of the protein from the different sources before such substitutes can be recommended for general use. Even soya bean milk which is said to approach natural milk in many respects has not attained universal popularity and opinions are divided regarding its digestibility.

Acknowledgements: My thanks are due to Sri H. Shiva Rao, B. Sc., Dip. Agri. (Cantab), A. R. I. C., the then Government Agricultural Chemist for having given me the opportunity to take up this piece of work and to Sri K. Govindan Nair, Assistant Agricultural Chemist, for his interest and guidance in the work.

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TABLE I

Notes on Quality of Different Milk Substitute

Name of milk	Colour	Odour	Taste	On boiling	Whole milk relished or not	Added to tea	Added to coffee
Cotton seed	Yellowish	Smell of soaked cotton seed not unpleasant	Acidic, not pleasant	Colour changes to yellow. Fine curds formed	Not relished	Raw milk seems all right. But on keeping precipitates are formed. When boiled milk is added a precipitate is formed.	Flavour and colour not bad. Taste—slightly bitter.
Coconut	Milk-White	Aromatic not unpleasant	Good and nutty	Curdles	Not bad	Raw milk flavour is not much affected. Fine precipitate appears. Boiled milk curdles.	Raw milk flavour is not unpleasant. Boiled milk is also all right. There is some after taste in either case.
Groundnut	Brownish white	Of crushed groundnuts	Acid and sweet	Coagulates	Not relished	Raw milk curdles. Taste not good.	Mixes well—Taste not good.
Black gram	Greenish white	Strongly of germinating seeds	Insipid	Thickens	Repulsive	Raw milk does not curdle, but taste is bad. Boiled milk curdles.	Raw milk or boiled milk mixes well. The taste is bad.
Bab lab	Brownish	Strongly of lab lab	Insipid	No change but odour increases	Repulsive	Raw milk does not curdle. Boiled milk curdles. Not relished by people.	Raw milk has a strong odour of lab lab, odour is imparted to coffee. Boiled milk curdles. Not relished.
Bengalgram	Creamy yellow	Fresh vegetable odour	Insipid	Thickens	Unpleasant	Raw milk as well as boiled milk also curdles.	Raw milk mixes well. Boiled milk curdles. Taste not good.
Horse gram	Brownish white	Characteristic odour of horse gram	Insipid slightly acid	..	Unpleasant	Mixes well but taste is not good.	Flavour is not much affected. Slight sour taste lingers on for a long time.

TABLE II

Showing the Composition of the Various Vegetable Milks

Name of milk	Specific gravity	pH at 29° C	Acidity as number of milligrams of KOH per 100 ml. milk	Moisture	Ash	Protein	Fat	Carbohydrates
Coconut ..	0·997	6·39	56	79·33	0·50	1·68	16·15	2·34
Cotton seed ..	1·020	6·86	257·6	88·04	0·85	4·42	4·98	1·71
Groundnut ..	1·018	6·78	89·6	72·22	0·64	6·79	14·40	5·95
Blackgram ..	0·945	6·65	22·4	97·47	0·18	1·02	0·61	0·72
Lab lab ..	1·028	6·21	..	90·50	0·75	5·32	0·54	2·89
Bengal gram ..	1·024	6·42	..	90·72	0·31	3·04	0·52	5·41
Cow's milk ..	1·030	6·90	67	87·30	0·80	3·20	3·50	5·20
Soya Bean milk ..	..	..	..	87·03	0·52	2·40	0·15	6·90

The Improvement of the Quality of Straw in *Talaivirichan Cholam* (Sorghum Roxburghii) in Madras State

by

P. KRISHNA RAO, Millet Specialist

and

K. NARASIMHAMURTY, Assistant in Millets

Introduction: *Talaivirichan* Cholam (*Sorghum Roxburghii* var *hians* Stapf), (Snowden 1936) is one of the important Sorghum varieties in the Madras State. It has got rather a discontinuous distribution, being cultivated on the hill slopes of Visakhapatnam and East Godavari districts and after a long gap occurring again in the Central districts of Chittoor, North Arcot, South Arcot, eastern portions of Salem and in the north-eastern portions of Tiruchirapalli districts.

The stalks of *Talaivirichan* Cholam grow to a thickness of nearly 1½" diameter and are very coarse and pithy. The straw of this variety is not relished by cattle because of its coarseness, and it is generally used only for thatch and fuel purposes. There are no naturally occurring juicy-stalked types in this variety or in the varieties allied to it. The problem of improving the quality of straw to make it fit for fodder was taken up as one of the items of work in the improvement of Sorghums of Madras State.

With this object a juicy-stemmed type, A. S. 5945, isolated from a cross was selected as a parent and some of the high yielding *Talaivirichan* cholam varieties were crossed with it in 1938. During the subsequent generations selections were made and purified to obtain pure-breeding forms of juicy-stalked *Talavirichan* cholam.

The F_1. plants from the above crosses were all white-mid-ribbed, since white midrib, which is indicative of pithy-stalked condition, is a simple dominant to dull green colour of the midrib, which indicates the juicy condition of the stalk (Rangaswamy Iyengar et al 1936). From the F_2. generation onwards segregations were obtained for juiciness and for certain other characters in which the parents were differing from each other. The process of selection from each generation was continued to obtain pure breeding forms for all characters including the juiciness of stalk. A. S. 7657, was finally selected as the best recombination. The first yield trial with it was conducted in 1950 main season with Co. 3 the standard strain of *Talaivirichan* Cholam. The results of the trial are presented below:

TABLE I

Selection	A. S. 7657	Co. 2	A. S. 8008	Co. 3	Critical difference
Grain yield as percentage of Co. 3 ..	132	116	115	100	16·1
Straw yield as percentage ..	102·2	96·1	97 6	100	Not significant

Note: Co. 2 and A. S. 8008, two other *Talaivirichan* Cholam selections were also included in the yield trial.

From the above four selections juice was extracted at the time of flowering and analysed for sucrose and glucose. The data are presented below as total sugars:

TABLE II

Selection No.		Extraction percentage	Total sugars in 100 lb. of stalks
A. S. 7657	..	22·5	0·9225 lb.
Co. 2	..	10·0	0·47 lb.
Co. 3	..	7·5 10·0	0·3728 lb.
A. S. 8008	..	10 0	0·558 lb.

To find out the relative food value of the selections and strains the straw was chemically analysed and the results of analysis are presented below:

TABLE III

(Results are expressed as percentages)

Particulars	Varieties							
	Co. 3		Co. 2		A. S. 8008		A. S. 7657	
	a	b	a	b	a	b	a	b
Moisture ..	6·84	..	7·17	..	7 35	..	7·88	..
Ash ..	7·34	7·88	6 86	7·39	7 35	7·94	9·65	10·47
Crude protein ..	2·73	2·93	3·82	4·12	4 29	4·64	6·04	6·56
Ether extractive ..	2·21	2 37	2 54	2·74	2·42	2 62	3·04	3·30
Crude fibre ..	28·72	30 83	21·24	22 89	25·05	27·03	22·31	24·42
Carbohydrates by difference ..	52·16	55·99	58·37	62·86	53 54	57·07	51·08	55·45
Total ..	100·00	100·00	100 00	100·00	100 00	100·00	100 00	100·00
Lime (CaO) ..	0·15	0·16	0·26	0·28	0·67	0·73	0·93	0·10
Phosphoric acid P_2O_5 ..	0·26	0·28	0·61	0·66	0·25	0·27	0·57	0·82
Nutritive ratio ..	20·98 : 1		16·78 :		13·74		9·61	

(a) Air-dry basis. (b) Oven-dry basis.

From the point of view of feeding, variety A. S. 7657 is the best of the lot, followed by A. S. 8008, Co. 2 and Co. 3 in descending order of merit.

It will be seen from Table I that the selection A. S. 7657 is significantly superior in grain yield to the standard Co. 3. In straw yield it was equal to the standard, with the advantage that the stalks are juicy.

The data in Table II show that the juicy-stalked selection A. S. 7657 has almost double the quantity of total sugars as in strain Co. 2 and nearly one and a half times more total sugars to that contained in Co. 3. The chemical analysis of straw presented in Table III showed that A. S. 7657 has the best fodder value. Feeding trials conducted with the straw of A. S. 7657 and the *Talaivirichan* cholam selections Co. 2 and Co. 3 indicated that the cattle relished the improved type better than the ordinary strains of *Talaivirichan* cholam.

Summary: *Talaivirichan* cholam is one of the important dry-land cholam varieties of Madras State. Its straw is inferior, being thick, coarse and pithy. To improve the fodder quality it was crossed with a juicy-stalked type and by selecting from the hybrid material through subsequent generations, one selection A. S. 7657, breeding pure for juiciness of stalk and other characters has been evolved. Its grain yields have been found to be significantly better than the standard. Its straw yield was equal to the standard and has the advantage of being juicy. It has practically double the quantity of total sugars to those of the standard, and has a better fodder value and palatability, as assessed by chemical analysis of straw and feeding trials.

Acknowledgments: The authors are indebted to the Government Agricultural Chemist for the analysis of the straw samples, for estimation of sugar and fodder value. The authors also express their thanks to Sri M. A. Sankara Ayyar, who effected the first cross.

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MADRAS

Note on the Presence of Branched Stigmas in *Pennisetum Typhoides*, Stapf and Hubbard.

In the course of field studies on *Pennisetum typhoides*, (Cumbu or Pearl millet), during the monsoon season, 1951, an interesting morphological character was observed in the spikelets.

In Gramineae, the gynoecium has generally two styles each with one plumose stigma (1) in rare cases, as in a few types of *Bambusae*, three styles each having a stigma may be present. The three-styled condition has been recorded in *Oryza grandiglumis*, Prodoehl, and in grain sorghums (2), (3) According to Walker (5) in the tricarpellate pistils of Andropogoneae, two of the carpels normally form the bulk of the ovary and bear the stylar branches while the third carpel bears the ovule. The normal pistil of *Pennisetum typhoides*, has only two styles which are generally connate at the base and each of the two styles has a single plumose stigma at its end.

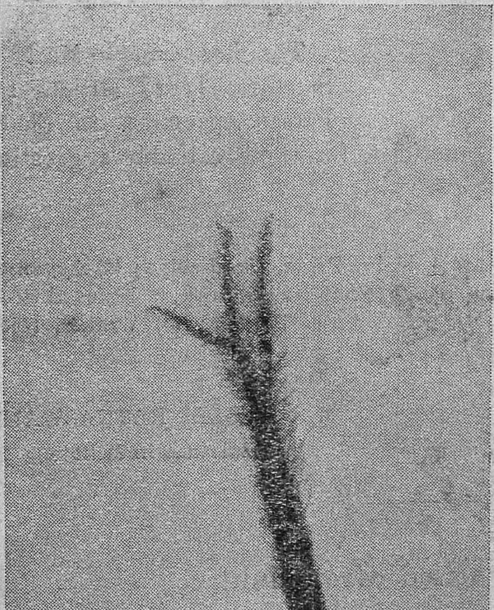

Fig. 1

Among the selections under study at the Millet Breeding Station, Coimbatore, two types, M. S 5965/6-2 selected from an African variety and M. S. 6355/6-1 selected from a Punjab variety, showed some of the panicles possessing a few spikelets having pistils with three or four stigmas (Figs 1 and 2). The extra stigmas do not show any morphological difference from the normal ones. In M S. 5965/6-1 in a single panicle of 994 spikelets, 24 spikelets had pistils with three stigmas and five with four stigmas while the rest had normal two stigmas. In another panicle, from the same selection, having 1,323 spikelets, 26 had pistils with three stigmas and two with four stigmas, while the rest possessed the normal two stigmas. The selfed progeny of the panicle that exhibited this peculiarity of branching of stigmas, when grown in the following season

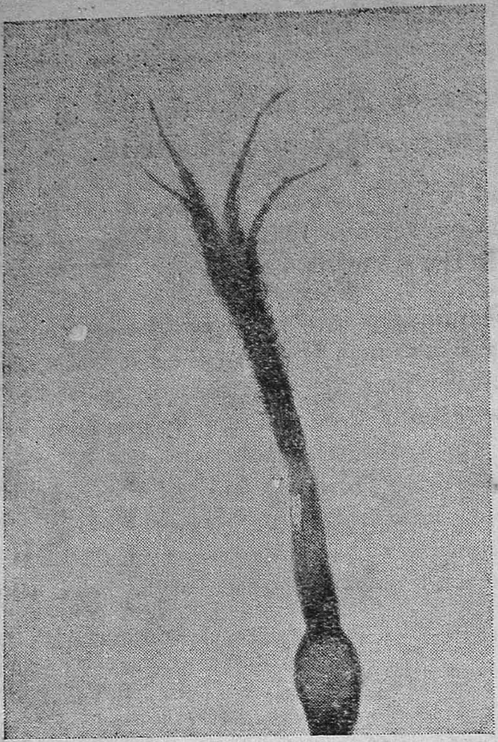

Fig. 2

(Summer 1952), repeated the behaviour. The other floral parts of these spikelets with three or four stigmas were normal in all characters. Ray (4) has recorded the presence of a third style in *Orzay sativa*, Linn. in eight varieties, in a proportion which was more than 42 percent. Two other varieties had more than 82 per cent of the florets containing this extra style. The presence of branched stigmas in Cumbu in particular selections and its repetition of the same behaviour in the following season cannot therefore be regarded as a mere freak of nature.

Thanks are due to Mr. M. A. Sankara Iyer, Millets and Pulses Specialist in charge and Dr. N. Krishnaswamy, Cytogeneticist, for their valuable suggestions in the preparation of this note.

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(1) Arber, A., 1934, The Gramineae. Univ. Press, Cambridge; (2) Ayyangar. G. N. R., et al (1935), Curr. Sci. 4 : 176; (3) Chandrasekharan, S. N., et al (1950), Curr. Sci. 19 : 291; (4) Ray, G. L, (1951), Sci. & Cult. 16 : 371; (5) Walker, (1906), Quoted in reference 2.

Millets Breeding Station,
Coimbatore,
August 1953.

M. CHARLES RATNASWAMY,
Assistant in Millets.

White - Kernelled Groundnut

An extensive collection consisting of 37 bunch and 48 semi-spreading and spreading varieties of groundnut is maintained at the Agricultural Research Station, Tindivanam for the past several years. These varieties were studied in detail and a key to their classification prepared by John, Narayana and Seshadri. Habit of growth and seed coat (testa) colour are the main characters based on which the different varieties are classified. Ninety-nine new varieties

obtained from various countries like Australia, East Africa, etc., were studied and their position fixed in one or other of the different sub-groups. But three white-seeded bunch varieties do not fit into any existing group. These varieties are pure-breeding and have attractive white-coloured kernels, the white colour being more pronounced than in A. H. 259 (Philippine white) — spreading variety.

The bunch varieties have been divided into four main groups depending on the seed colour, viz, (1) light rose (ii) rose (iii) red and (iv) dark purple. The three white-kernelled bunch varieties have to be placed in a new group in the classification list. Accordingly the following new group is constituted:—

White-kernelled bunch group: Varieties coming under this group are characterised by the almost complete absence of anthocyanin pigment on the stem and the leaves, pale green colour of leaves, absence of the crescent in the standard petal and white seed coat colour. This group is further divided depending on the kernelled nature of pods.

Type 1: 1—2 seeded pods; pods-small sized; deep to medium constriction; the back is peculiar with a distinct curve A. H. 6644 (East Africa).

Type 2: 1—3 seeded pods; pods-medium sized; medium to shallow constriction; the purple veinetion in the standard is slightly more pronounced than in type 1—A. H. 6728 and A. H. 6744 (both from Australia).

The white coloured nature of kernels is a very desirable character because such types will give an almost colourless oil and considerably reduce the cost of decolorisation of the oil in the Vanaspathi industry. Evolving a white-seeded type by crossing a high yielding pure line with A. H. 259 is one of the items in the breeding programme. The new short-duration white-kernelled bunch types are now being utilised for the same purpose. Selection work in these varieties has also been taken up to spot out high yielding pure lines, if any.

John C. M., Venkatanarayana G., and Seshadri C. R. - Variety and forms of the Groundnut(*Arachis hypogea* Linn). — Their classification and economic characsters (paper under publication with the Indian Central Oilseeds Committee). G. Venkatanaraya (1952)-Groundnut in Madras and its Economic Importance-Madras Agric. J.—Vol. XXXIX.

Agricultural Research Station, Tindivanam, South Arcot District

M. BHAVANI SANKAR RAO
N. SRINIVASALU

Note on Caryota Urens. L. The Bastard Sago

Caryota Urens. L. a handsome palm indigenous to Ceylon, Malaya and India, thrives well under varied climatic and soil conditions but is mostly confined to elevations ranging from sea level to 2,500 feet, especially the rain forests. The tree attains its full size in 12–15 years reaching a height of 30–40 feet and bearing huge, long, pendulous, attractive infloresceneses after about 8 to 12 years of growth.

Propagation of the tree is only by seed. It has been commonly observed that the self-sown seeds germinate in 5 to 6 months. Experience at the Kallar Fruit Station has shown that the stored seeds generally lose their viability after six months. Trials on the germination of seeds under different treatments has shown that seeds pre-soaked in cold water for 24 hours recorded the maximum germination of 71·5 percent. The earliest germination by this treatment was observed in 90 days. Though the pre-soaking of the seeds in coconut milk reduced the period i.e., in 86 days, the percentage germination obtained thereby was far less. Scarification of the seeds with sand prior to sowing gave 66% germination. It was therefore evident that pre-soaking of the seeds in cold water for 24 hours prior to sowing ensures the best results in germination.

The economic uses of this tree are many. The leaves yield a strong, durable fibre popularly known as 'Kuttul or Kithul fibre' largely used in rope making, preparation of brushes, baskets and other articles. The fibre of the sheathing petiole gives the commercial bristle fibre which is used for making fishing twines. The long, pendulous inflorescences are often used for decoration The young inflorescence when cut, yields a copious supply of "sweet sap" or palm wine, from which brown sugar is manufactured The 'wine' as such is also consumed. The pith of the trunk of the mature tree yields an excellent sago. Bread, 'dosai' and thick gruel are made out of it. This is also a popular famine food in many parts of South India, especially on the hills. The immature seeds of the palm are sometimes used as adulterants with chopped arecanuts. They yield a blackish-red liquid when boiled with water and the dye is at times used for colouring arecanuts. The tree trunks are sometimes used as conduits for water. In view of these economic uses which it has, besides its graceful and ornamental appearance this palm deserves a large-scale cultivation in all suitable situations.

I. K. SAMBASIVA RAO, B. Sc. (Ag.) D. I. H.

Correspondence

Sri B.W.X. Ponnaiya and L. Anavaradan write from the Agricultural Research Station, Koilpatti that in the Tenkasi area after the harvest of main season paddy black gram is sown mixed with a long duration sorghum 3 : 1½ lb. per acre. The local farmers know by experience that young sorghum plants are poisonous and often fatal. This effectively prevents the black gram being grazed by cattle. They recommend this usage to be tried in the case of *Sesbania speciosa* also.

Dear Sir,

We wish to draw your attention to the article on "Economics of chemical control of weeds control of *Portulaca quadrifida.* L. in West Godavari District (Madras Agric. J. XL. No 12/1953).

There also appears to be a mistake in calculating the amount of Extar 'A' required per acre. The article says 200 gallons of Extar 'A' spray per acre gave satisfactory results and that only 20 gallons were required for the second spraying to achieve complete control. Therefore, the amount of Extar 'A' required for two sprayings i.e. for 200 gallons at conc. of 0·8% works out to 18 lb. per acre and not 44 lb. as shown in the article.

We would thank you to let us know if our above assumption is correct and if so to insert a note to that effect in the next issue of your magazine.

(From Messrs. Sandoz Products, Ltd., Bombay - 1. Dated 12—1—1954)

* * * *

Sir,

There is no mistake in calculating the Extar Sandoz 'A' required per acre as 0·8% refers to DNOC content and not that of Extar 'A'. 0·8 strength of DNOC is contained in 2 lb. of Extar A. To make 0 8% strength of DNOC 2 lb of Extar A should be dissolved in 100 lb. of water or 10 gallons of water. To make 220 gallons of spray fluid containing 0 8% of DNOC 44 lb. of Extar Sandoz A are required. At Rs. 3—2—0 per lb., 44 lb cost Rs. 137—8—0.

(From P. Govinda Rao, B. Sc. (Ag.), Agricultural Mycologist, Bapatla. Dated 1—2—1954).

Government of Madras G. O. Ms. No. 253; dated the 2nd December, 1953, Agriculture Department—Extracts

Order: In its petition read above, the Association of Upper subordinates of the Madras Agricultural Department, Coimbatore, has submitted certain resolutions passed at its general body meeting in November, 1952 for favourable consideration of the Government. The Government have examined the several points raised by the Association and pass the following orders:

* * * *

The Association has represented that there should be no condition that an upper subordinate should submit his resignation, if he gets selected to a post under foreign service. The Government have decided that persons applying for appointment elsewhere need not give an undertaking to resign their posts in the Department if they get selected for the jobs applied for by them, though the question of forwarding an application for employment elsewhere will be decided with reference to the merits of each case, giving due regard to the exigencies of service. The question whether a person who succeeds in getting selected for a post elsewhere should be allowed to take it up or not and if allowed under what conditions shall, however, be within the absolute discretion of Government.

The Association has stated that every third vacancy in the Gazetted Posts of District Agricultural Officers is now filled by direct recruitment and has requested that direct recruitment to these posts may be stopped for some years to alleviate the stagnation among senior hands. The statement of the Association is incorrect as the ratio of appointments by direct recruitment and those by transfer is 1:4 and 1:2. The question of reducing the proportion of substantive vacancies to be filled by direct recruitment to gazetted posts of District Agricultural Officers was considered before by the Government. The Director of Agriculture then proposed to stop direct recruitment to the posts but the Government did not accept the proposal. The Government have further examined the question in consultation with the Director of Agriculture and now direct, with the concurrence of the Public Service Commission that the proportion of substantive vacancies to be filled by direct recruitment and transfer shall be reduced from 1:4 to 1:7 Necessary amendments to the Special Rules for the Madras Agricultural Service will issue separately. (By order of the Governor of Madras).

* * * *

Government Loans to Ryots of Nilgiris District for Soil Conservation

Government have approved in G. O. Ms No. 1. Agricultural Department dated 21—1—1954 that the ryots of Nilgiris District may be granted loans under the Madras Land Improvement Act upto a maximum of Rs. 1,500/- per ryot for carrying out soil conservation works. The loan will be granted by the Revenue Department subject to the following conditions.

(i) Only 50% of the loan amount will be given before the execution of the work and the balance 50% will be given after the completion of the work.

(ii) The work should be carried out as per the directions of the Assistant Agricultural Engineer, Soil Conservation Scheme, Ooty or his staff who will mark out contour lines and render all help in the execution of soil conservation. (Director of Agriculture).

* * *

The following student scholarships are available under Fulbright Programme: (a) *United States Government Scholarships* · These scholarships provide full support, inclnding tuition and maintenance. The amount of the scholarships varies from university to university according to the cost of living, usually from ranging $ 125 00 to $ 180·00 per month.

(b) *Scholarships and Assistantships*, given by private organisations. (These are also offered through the Institute of International Education and applications are received by the Foundation).

(c) *Travel Grants* (Fulbright), provide round-trip travel between India and America to supplement the scholarships described above.

The announcement of the competition for full scholarships including travel is usually made in the Press in July of each year for the following academic year commencing in September Competition is open for one month, from mid-July to mid-August. These scholarships are available for *one academic year only*. There are no written examinations. If a candidate fulfills the minimum requirements he may secure a preliminary application from one of the addresses listed below. These will be distributed *only at the time of the competition.*

The Executive Secretary, United States Educational Foundation in India; 17, Curzon Road, New Delhi.

Or to the nearest Cultural Officer, United States Information Service, (*i*) *158 Mount Road, Madras* (*ii*) *Adelphi, 3 Queens Road, Bombay* (*ii*) *7 Chowringhee* Road, Calcutta 13.

Minimum Requirements : For the 1953—54 student scholarship competition, an applicant must satisfy the following minimum requirements :-

(a) Possess a post-graduate degree or diploma. Either this or the Bachelor's degree must be a first class; (b) Have two years of experience in the field of his specialization following the post-graduate degree or diploma; (c) Be between 24 and 35 years of age at the time of application; (d) Be in India at the time of application and selection; (e) Not have studied previously in the United States at the college level; (f) Be a citizen of India; (g) Be in good health; (h) Be proficient in English.

The scholarships are available only in the humanities, social sciences, (theoretical and applied), and in the pure sciences. No applications in applied sciences, technologies and medicine are accepted. Regulations governing qualifications and fields of study can be changed annually by the Board of Directors.

Fulbright Travel Only : A second competition is held in the spring of each year for those students who need only a Fulbright travel grant. Competition for such grants is open usually from *January to the middle of April. A travel grant* will cover the cost of transportation from the grantee's home in India to his destination in the United States and return by the most direct route. In order to apply, the studeut must present to the United States Educational Foundation in India (1) an official letter of admission from an American university for the September session, and (2) proof of adequate financial support, either in the form *of grants from the* university or from private funds amounting to at least Rs. 10,000/- for each year of study. Requests for applications must be accompanied by these two documents. All documents, unless in original, *must be properly certified* by a first class magistrate. Applications for travel grants will be received in all fields of study but preference will be given to the arts, humanities, social sciences and pure sciences. In general the same qualifications apply as in the scholarship competition.

The Foundation is responsible for making travel arrangements for all grantees receiving Smith-Mundt awards and Fulbright travel grants.

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Extracts and Gleanings

Brackish Sea or Salt Water Converted to Pure Water: Demineralization of brackish water for agricultural, irrigational, industrial and household purposes has been made possible by research both in India and U. S. A. The traditional method of distilling is too expensive. But in the past two decades research has helped to remove the salt from the water instead of the water from the salt as in distillation. One of the most promising processes known commercially in U. S. A. is the Nepton Demineralizer technique. It consists of newly invented plastic membranes which have the capacity of breaking up the salt into sodium and chlorine ions, the ions are divided and passed into waste channels and pure water run off by a separate channel. In India, work has been done in laboratory scale at the National Chemical Laboratories, Poona, Fuel Research Institute, Jeolgora (Dhanbad) and the Indian Institute of Science, Bangalore, to convert brackish water into pure water. This has been mainly by the use of ion-exchange material. (American Reporter, December 23, 1953) (A. M. K.)

Early Spraying of *Plants Urged to Prevent* Blight: Spraying or dusting fungicides on potato and tomato plants when they are just beginning to sprout will remove the danger of any crop destruction caused by late blights. Blights develop during cool damp weather and spraying or dusting during this period will keep plant diseases under control. Tomato plants should be sprayed or dusted two or three weeks after the plants have been set in the field. Continued spraying at weekly intervals during the damp period is recommended for both.

On tomatoes the blight causes a firm rot, usually starting near the stem end. The tomato skin becomes wrinkled and develops brownish-green specks or blotches. The rotted spot may spread over one-third to one-half of the fruit within two days. Sprays and dusts that will help control the blight may also contain chemicals that will control insects. (51—A—10.)

Ethylene dibromide is used as a fumigant on perishable foods to destroy the Oriental fruit fly, the melon fly, and the Mediterranean fruit fly without during to the commodity. The chemical is applied to the commodities at the rate of 1 pound per 2,000 cubic feet of space over a two-hour period at 70 degrees Fahrenheit. The treatment is for use on avocados, bell peppers, melons, bananas, cucumbers, papayas, pine-apples, string beans, and squashes. (American Agriculture, 51—A—12. 1951) (T. V. S.)

AGRICULTURAL NEWSLETTER

Animal Husbandry: *Treatment of mastitis*:— Mastitis is an inflammatory condition of the mammary glands. It is frequently seen in heavy milkers and is due to infection of the gland by micro organisms. The commonest organisms responsible are Streptococci and Staphylococci. Clinically two forms of mastitis are seen, "acute and chronic". Infection takes place through the teats either from the unhygienic surroundings or more commonly through wounds on the teat and udder caused accidentally by rough milking, tread-wounds from adjacent animals or wounds caused by horns or other sharp objects.

In the acute type there is an immediate increase in the size of the quarter. The quarter is hot and painful, red in colour and the animal resents milking or manipulation of the udder. The milk in early stages might not show any change but after some time, gets clotted and tinged with blood and will not flow freely from the teat. In the chronic form there is no appreciable change at first except a gradual reduction in milk yield and reduction in the size of the quarter. In some

cases, if neglected, the quarter might get completely atrophied. The milk has also a tendency to curdle on boiling. Flakes may be found when stripped on to a black cloth, It is a good practice to test even apparently healthy cows in this manner periodically. With the advent of modern antibiotics, treatment is successful in 75 per cent of the cases, if the condition is detected in time before serious damage to the gland is caused. Neglect may lead to complete loss of one or more quarters. The help of a Veterinary Surgeon should be sought without delay.

Milking animals should be kept in hygienic surroundings. Before and after milking, the quarter should be cleansed with a weak antiseptic lotion as Dettol or Cetcvelon (I. C. I) one per cent solution. Wounds in the region of the udder and teats should not be neglected as they are likely to come in contact with dung and urine. Hence, they must be immediately cleaned with an antiseptic ointment or Penicillin ointment.

Fisheries : Stepping up production of fish protein is tackled by the Fisheries Department on four major lines i. e., (1) Increasing the harvest of fish crop by intensified stocking of inland waters with suitable quick-growing fish seeds and side by side with judicious and scientific exploitation of waters (2) prevention of spoilage at every stage by providing quick transport facilities and installation of cold stores at important production centres, (3) intensified deep-sea fishing operations with motor vessels and the mechanisation of indigenous craft and (4) supply of essential articles like salt, yarn, sail cloth, etc., to fishermen at subsidised rates.

There are about 4 lakhs acres of inland waters in the State, of which 15,000 acres have been stocked with suitable quick-growing carps like Catla, Cirrhina, Labeo and Chanoes, etc. Arrangements are being made to populate the remaining waters also with quick-growing species of fishes. Fish seeds are distributed to interested pisciculturists at concessional rates by the Fisheries Department. (Director of Information and Publicity, Madras).

Examination question :— Write short notes on Theory of acquired characters.

Answer-1. Example - Zerophy. The elongation of the neck is an acquired character.

Answer-2. Another example can be given. Suppose a child born to a good family brought and fed under robbery atmosphere. The child will be gradually acquires the robbery atmosphere and in course of time become an outstanding robber. But his genotype is not robber but he got this from atmosphere.

Weather Review — For the month of January, 1954.

RAINFALL DATA

Division	Station	Total rainfall for the month in inches.	Departure fromnormal in inches	Total since 1st January in inches
North	Madras (Meenambakkam)	2·7	+ 1 3	2·7
	Tirurkuppam*	3·1	+ 2·2	3·1
	Vellore	2·3	+ 0·8	2·3
	Gudiyatham*	2·0	+ 1·8	2·0
East Cost	Palur*	2·7	+ 0·7	2·7
	Tindivanam*	3·0	+ 1·6	3·0
	Cuddalore	5·2	+ 2·8	5·2
	Nagapattinam	4·9	+ 2·2	4·9
	Aduturai*	2·6	+ 1·0	2·6
	Pattukottai*	4·2	+ 2·3	4·2
Central	Salem	1·0	+ 0·7	1·0
	Coimbatore (A. M. O.)*	3·4	+ 3·2	3·4
	Coimbatore	3·5	+ 2·9	3 5
	Tiruchirappalli	1·8	+ 1·0	1·8

Division	Station	Total rainfall for the month in inches.	Departure fromnormal in inches	Total since 1st January in inches
South	Madurai	3·4	+ 2·6	3·4
	Pamban	2·7	+ 0·1	2·7
	Koilpatti*	4·4	+ 3·8	4·4
	Palayamcottai	3·3	+ 1·6	3·3
	Ambasamudram*	7 7	+ 5·2	7·7
West Coast	Trivandrum	2·1	+ 1·3	2·1
	Fort Cochin	1·5	+ 0·6	1·5
	Kozhikode	0·2	J. N.	0·2
	Pattambi*	0·0	— 0·1	0·0
	Taliparamba*	0·5	+ 0 4	0·5
	Wynaad*	Tr.	— 0 4	Tr.
	Nileshwar*	0·3	+ 0·1	0·3
	Pilicode*	0·2	— 0 1	0·2
	Mangalore	0·3	J. N.	0 3
	Kankanady*	0·4	+ 0·4	0·4
Hills	Kodaikanal	6·8	+ 3·6	6·8
	Coonoor*	8·4	+ 4·5	8·4
	Ootacamund*	2·0	+ 1·1	2·0
	Nanjanad*	1·8	+ 1·0	1·8

Note.— 1. * Meteorological Stations of the Madras Agricultural Department.

2. For Kanakanady actual rainfall and deviation are respectively 44 and 37 cents.

3. Tr = 1 to 4 cents of rain-fall.

4. J. N. = Just Normal.

Weather Review for January 1954

The month began with a western disturbance over Vindhya Pradesh and east Uttar Pradesh. It became unimportant the next day and continental air prevailed practically over the entire country. In the subsequent eight days western disturbances occurred in different parts of the country. On 11-1-1954 under the influence of a secondary western disturbance, moving eastwards across Maldivies area, considerable incursion of moist air took place in the extreme South Peninsula. For four days thereafter a few isolated western disturbances were observed. On 16-1-1954 dry continental air prevailed in the country outside the extreme South Peninsula and upper Assam. A cyclonic circulation existed over Sind on the next day. The developments that ensued in the succeeding two days resulted in the incursion of moist air in the North East India upto 3,000 ft. a. s. l. This disturbance continued for two days.

On 23-1-1954 North-west India, South-west Uttar Pradesh, the Central parts of the Country and Chota Nagpur experienced cold wave. The remaining portion of the month went off with a few western disturbances noted in different parts of the country.

Almost all the districts in the Madras State had some showers in January, 1954. The districts constituting the southern region received fairly good rains. In regard to noteworthy falls only Coimbatore recorded 2·00" of rain on 5-1-1954. Details of the zonal rainfall are furnished hereunder:

S. No.	Name of the Zone		Average rainfall for the month in inches	Departure from normal in inches	Remarks
1.	North	..	2·53	+ 1·53	Above Normal
2.	East Coast	..	3·77	+ 1·77	do.
3.	Central	..	2·43	+ 1·95	do.
4.	South	..	4·30	+ 2·66	do.
5.	West Coast	..	0·55	+ 0·22	do.
6.	Hills	..	4·75	+ 2·55	do.

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, —2—1954.

C. B. M. & M. V. J.

A young author wrote asking a famous editor for advice on writing successful short stories.

The editor replied that it must be short and to the point, (2) it should contain a religious touch, (3) have some reference to the aristocracy (4) have action and (5) also some sex appeal. Next day the author sent along the following: "Good Heavens!" said the Duchess, "You're pulling my leg!".

Departmental Notifications

Gazetted Service—Postings and Transfers

Madras State: Francis, T. S., D. A. O. Ootacamund, Senior D. A. O. Crop Sampling, Madras; Krishnaswami, P. N., Cotton Certification, Asst. Rajapalayam, Gazetted Asst. to Cotton Certification Officer, Rajapalayam; Krishnamurthy, K. S., D. A. O. on leave, D. A. O. Madurai; Mohamed Ali, Senior D. A. O. Crop Sampling, Madras, Dy. Director of Agriculture, Madurai; Mayandi Pillai, Asst. Cotton Specialist, Koilpatti, Cotton Certification Officer, Rajapalayam; Narayanan, N. G., Asst. Cotton Specialist, Srivilliputhoor; Rangaswami, T. V., Asst. Cotton Specialist, Coimbatore, Cotton Certification Officer, Rajapalayam; Ramachandran, C. K., Asst. Cotton Specialist, Srivilliputhoor, Asst. Cotton Specialist, Koilpatti; Srinivasa Rao, B., D. A. O. under Training, Madras, D. A O. under Training Tanjore; Santhanam, V., Asst. in Cotton, Asst. Cotton Specialist, Coimbatore; Santhanam, K., D. A. O. Madurai, D. A. O. Ootacamund; Umapathy, M., Asst. Agrl. Eng. (Tractor Workshop) Coimbatore, Asst. Agrl. Eng. (Inspection) Madurai.

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its wake created a number of corollary industries. Even the very agriculture of cotton has been deeply influenced in several ways. The knotty problem for it to solve now are the questions of handloom weavers and modernisation. In the latter, the industry has to reorient its views completely. It has to recognise the place of fundamental research in the progress of any real industry. At present there are only a few Government sponsored institutes for research and institutes for training in textile branches. It is very necessary that the industry should set up endowments for conducting fundamental researches in all branches of textile science and sponsor on its own institutes and research centres in all important places. What more, it should be the minimum requirement for all mills etc. to maintain research laboratories themselves to solve their immediate problems. We hope that the industry will emerge at no distant date fully modernised and once more place India as the foremost textile producer of the world.

Our New Patron: We welcome with great pleasure Shri K. P. Amrithanatha Iyer of Monkompu, Travancore Cochin State as a patron of the Madras Agricultural Union. He has been for long a subscriber to this Journal. Shri Iyer is a keen and practical agriculturist dealing with a variety of crops such as paddy, coconut, tea, rubber, pepper, arecanut, etc. He has been actively concerned with many nation building agricultural and co-operative organizations. He was a member of the Food and Grains Committee, I. C. A. R. New Delhi and also of the Irrigation Committee. He is now a member of the Food and Advisory Board, the District Development Committee, the Central Milk Board, Project Advisory Board—Kuttanad, Community Project Travancore-Cochin State and is also the president of the Milk Union and Taluk Co-operative Union Allepy, T. C. He was awarded a prize in the District Paddy Growing Competition. His deep interest in promoting scientific agriculture is further evinced in his offer to co-operate in all possible ways in conducting trials in his fields at his *own risk and expenditure*. Indian Agriculture needs many more such broadminded agriculturists.

A Note on the Technique of "Ranking" in Plant Breeding

by

T. V. RADHAKRISHNAN, B. Sc. (Ag.), M. Sc. (Ag.)
Assistant in Cotton, Srivilliputhur

Very often plant breeders face the difficulty of placing various types or cultures in order of merit for one or more of their attributes. Cotton varieties, for example might be ranked for their vigour, squaring or disease resistance into definite groups as better than, equal to or poorer than the standard (the local strain cultivated). New varieties under trial for the first time might be ranked in order of merit without assigning any numerical measure of intrinsic worth to each type. Ranking arises naturally in cases where for lack of time, money or instruments, measurement of a characteristic is considered impossible. It is not possible for a cotton breeder, for example, to count the number of bolls or squares of every type particularly when he deals with large collection of material. He can only rank these types into certain definite groups. We are sometimes forced to have recourse to ranking methods even when measurements have been made, in order to reduce the labour of computation or to get an idea of the general trend.

Spearman's rank correlation coefficient is the best known technique in this field. Suppose we have ten cotton types ranked for red-leaf resistance in order of merit by designating the decreasing grades of resistance as 1 to 10 by two observers. Let us also suppose that when the ten varieties are denoted by the letters A, B, C, ... J and the two observers as X and Y, the following ranking results are obtained.

Varieties	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
Ranked by observer X	2	1	3	4	6	5	8	7	10	9
Ranked by observer Y	3	2	1	4	6	7	5	9	10	8
Rank difference (Y—X) = d	1	1	-2	0	0	2	-3	2	0	-1
Sq. of difference = d^2	1	1	4	0	0	4	9	4	0	1

The problem is to find whether the two observers show evidence of agreement in regard to ranking. This is solved by Spearman's rank correlation co-efficient which is denoted by

$$R = 1 - \frac{6\, \Sigma d^2}{n^3 - n}$$

Where Σd^2 is the sum of squares of rank differences, and 'n' is the number of types ranked. In the above example Σd^2 is 24 with 'n' equal to 10, so that the correlation co-efficient is

$$R = 1 - \frac{6 \times 24}{1000 - 10} = 0{\cdot}85.$$

The rank correlation co-efficient has been so designed that the value will be plus 1 when the rankings are indentical and minus 1 when they are at their maximum disagreement. In the case of the example, the observers X and Y show a fair agreement between each other in their ranking of the varieties for their resistance to red leaf disease. But there is every possibility that the measure of agreement may have arisen by chance. In order to test it, we have to work out the significance of rank correlation co-efficient. If 'n', (the number of items ranked) is not less than 10, we may calculate Students 't' as $R\sqrt{\frac{n-2}{1-R^2}}$ with n—2 degrees of freedom. Making the necessary substitution in the formula we find

$$\text{Students} \quad t = 0{\cdot}85\sqrt{\frac{10-2}{1-85^2}} = 4{\cdot}55.$$

The value of 't' from table (P=0·01%) with 8 degrees of freedom is 3·355. As our value is higher than this, we conclude that the degree of agreement between the two observers is significant.

There is every possibility here that both the observers may be wrong in their rankings even though they may both agree. To test whether an individual is a good judge, we can use the same Spearman's rank correlation co-efficient. Suppose there are ten types of cotton, the number of squares produced by them are actually counted, the types are ranked by observer, the capacity of the observer is to be judged and the ranking recorded by him is as follows :

		A.	B.	C.	D.	E.	F.	G.	H.	I.	J.
True rank by actual counting		1	2	3	4	5	6	7	8	9	10
Rank given by the observer		3	2	4	1	7	5	10	6	9	8
d	=	2	0	1	-3	2	-1	3	-2	0	-2
d^2	=	4	0	1	9	4	1	9	4	0	4

which gives $\Sigma d^2 = 36$ with n=10.

$$R = 1 - \frac{6\ \Sigma d^2}{n^3 - n} = 1 - \frac{216}{990} = 0{\cdot}78$$

from which we can calculate.

$$\text{Students 't'} = R\sqrt{\frac{n-2}{1-R^2}} = 0{\cdot}78\sqrt{\frac{10-2}{1-0{\cdot}78^2}} = 3{\cdot}5.$$

The 1% level of Students 't' with n—2=8 degrees of freedom is 3·36. We therefore conclude that the observer's ranking correlates significantly with the true ranking.

Spearman's rank correlation co-efficient is thus a very useful technique in finding out (a) whether two independent observers show significant agreement between them in ranking a set of types and (b) whether an experimentalist is proficient enough to judge the various types by ranking them without any actual measurement.

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Some Studies of 2, 4-D Toxicity in Soils in Herbicidal Concentrations

by

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and
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It has been pointed out by many investigators in several instances that 2, 4-Dichlorophenoxy acetic acid, applied in herbicidal concentrations leaves toxic effects in the soils. Attempts have been made by workers to assess the persistence of its toxicity and in almost all these studies the emergence of certain seedling like tomato, cucumber and beans have been used as criteria. Nutman et al (1945) reported that 2, 4-D when applied in small quantities of herebicidal concentrations had some toxic effect on soil but it disappeared in a course of 36 days. Mitchell and Marth (1948) found soils kept in dry conditions were toxic even at the end of 18 months. De Rose (1946) Taylor (1947) and Kries (1947) all noted that 2, 4-D persists in soils and supresses germination and growth of plants. Brown and

Mitchell (1948), Carlson and Hamner (1948), Hernandez and Warren (1948), Akamine (1951) have shown that the inactivation of 2, 4-D was greatly influenced by factors like temperature, soil moisture, pH, soil type, organic matter, autoclaving, rainfall, and other environmental factors.

While all this work relates to temperate conditions of climate and soils, very little work has been done under tropical conditions in India. Some experiments were therefore conducted under regulated conditions in laboratory, in the Department of Agriculture, Annamalai University, using two types of soils showing two different pH values to study the toxic effects of 2, 4-D in the soils in a preliminary way.

Materials and Methods: The germination and growth of Indian flat beans *(Dolichos lablab)* sown at 2 week-intervals in treated and non-treated flats were used as critera for assessing the persistence of 2, 4-D toxicity in soils. Two types of soils, clayey and sandy loam with pH values of 7·8 and 6·5 respectively, were used in the experiment. Wooden flats of 18"x12"x9" were filled with the soil to a depth of 6". 2, 4-D was applied in pure acid form as a surface dust calculated at 2 lb. per acre. Fifty bean seeds were sown in each flat and at the end of 2 weeks, the extent of germination and number of normal and abnormal seedlings in treated flats were noted and the results compared with the control. These seedlings were pulled out and another sowing was made immediately. Cropping was thus continued until the germination and growth of seedlings in treated flats when expressed as a percentage of control was 95%, it was assumed that the toxicity was lost. For each type of soil two flats were treated and two flats were non-treated. The factor of leaching was prevented by allowing water in quantities just sufficient for germination and growth of plants. To be sure that the chemical had not been reached to the bottom, at the conclusion of the experiment the soil in the flats was inverted and bean seeds were sown and the germination and growth of seedlings observed.

Results: 2, 4-D showed toxic effects in sandy soils upto 8 weeks and in clayey soils upto 6 weeks. The toxicity was lost two weeks earlier in clayey soils. Irrespective of soils germinating bean seeds and seedlings exhibited various pattern of abnormalities in treated flats. The chief modifications were formation of swollen hypocotyl loop in certain seeds, reversion in germination, formation of an irregularly thickened cancerous growth at base of stems from which roots were given off, and alteration of size, shape, texture and

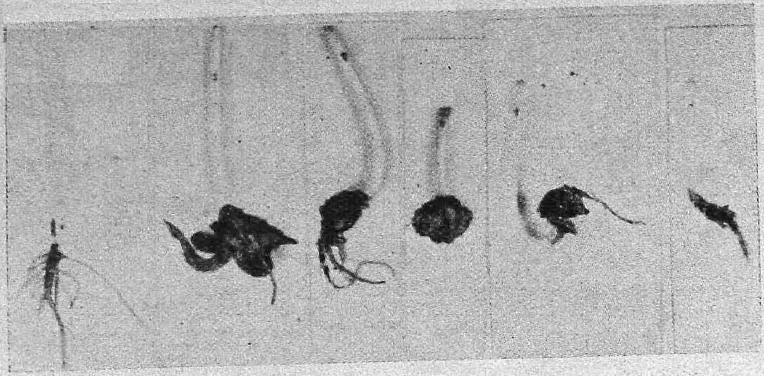

FIG. 1.
Cancerous growths at the base of stems of bean seedlings induced by 2, 4-D. Left extreme: Control.

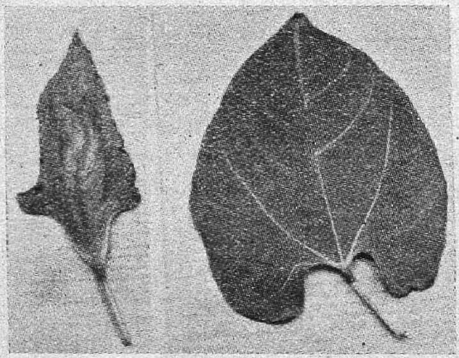

FIG. 2.
Alteration in shape, size and venation of bean leaves induced by 2, 4-D. Left: Treated. Right: Control.

venation of leaves in many cases. Fig. 1 shows the cancerous growth at the base of stems, and Fig. 2 the alteration of size, shape and venation of leaves. Table I shows the normal bean seedlings expressed as percentage of control until the toxicity was lost in both soils. Data were also collected with regard to the emergence of abnormal seeds and seedlings in flats treated with 2, 4-D at 2 weeks intervals in both soils until toxicity was lost and it is shown in Table II. The perusal of the data in Table I will indicate that there was a complete failure of emergence of normal seedlings for the first 4 weeks in flats treated with 2, 4-D irrespective of the soil types. It was interesting to note that while in sandy soils the emergence of normal seedlings gradually increased from the 4th to 8th week, it was rather abrupt in clayey soils. By the end of 4 weeks, there was sudden emergence of normal seedlings almost equalling the control in clayey soils.

TABLE I.

Percentage of emergence of normal bean seedlings at two week intervals in sandy and clayey soils treated with 2, 4-D.

	Sandy Soils			Clayey		
	Counts regarding emergence of normal seedlings					
Interval between treatment of 2, 4-D and sowing seeds (in weeks)	Treated	Non-treated	Normal seedlings expressed as % of control	Treated	Non-treated	Normal seedlings expressed as % of control
1·0	Nil	77	Nil	Nil	95	Nil
2·2	Nil	70	Nil	Nil	96	Nil
3·4	17	75	22·67	77	84	91·67
4·6	89	95	93·68	87	88	98·86
5·8	94	95	98·95	..	..	..

TABLE II

Abnormal seeds and seedlings expressed as a percentage of control at two week intervals in sandy soils and clayey soils treated with 2, 4-D

	Sandy soil		Clayey soil	
	Interval between application of 2, 4-D and sowing of bean seeds (in weeks)	Abnormal seeds and seedlings	Interval between application of 2, 4-D and sowing of bean seeds (in weeks)	Abnormal seedlings
1.	0	85·74	0	91·89
2.	2	80·00	2	75·00
3.	4	46·66	4	5·71
4.	6	5·26	6	Nil
5.	8	Nil	..	..

Discussion: In the results obtained with our experiments it is seen that sandy soil with 6·5 pH has retained toxicity for a longer time than the clayey soil with a pH value of 7·8. In these experiments except the variation in soil type and pH, every other factor of environment, like temperature, moisture etc. was the same for the different treatments. Akamine (1951) working in soils reported that soils high in pH value inactivated 2,4-D more rapidly than those low in pH value. In our experiments also soils with a higher pH value has shown inactivation nearly 2 weeks earlier than the soils lower in pH value. Thus our results are in consonance with those of Akamine. In general it is further noted that abnormal *seeds and seedlings* were altogether greater in sandy soils than in clayey, although during the first sowing, the abnormal seedlings were somewhat higher in clayey soils. Further, the sandy soil in the case of our experiment has shown longer period of retention of 2, 4-D than clayey soils. These suggest that 2,4-D is more toxic in sandy soils than *clayey one.* Nutman *et al (1945) in attempting to* find out the toxic effects of 2,4-D in different soil types report that in Rothamsted soil, a clayey one, 2,4-D had less marked effect than in Wouburn soil, a sandy one. It was also interesting to note in our experiments that while emergence of normal seedlings was gradual in sandy soil, it was rather abrupt in clayey soil. Modifications exhibited by bean seeds, and seedlings were similar to those described by Zimmerman and Hitchcock (1942), De Rose (1946) and Kries (1947).

It should be noted that the experiments were conducted under conditions where leaching was not permitted. When conducted under field conditions, the amount of rainfall in a place is also likely to influence the inactivation of 2,4-D and this has been pointed out by De Rose (1946).

Summary and Conclusions: 2,4-D was applied as surface dust in two types of soils with pH values 6·5 and 7·8 respectively at calculated rate of 2 lb. per acre. The germination and growth of bean plants were used as criteria for assessing toxicity of 2,4-D in herbicidal concentrations. The results within the limitations of the experiments indicate that soil type and pH considerably affect the inactivation of 2,4-D in herbicidal concentrations. Soils with high pH value inactivated the herbicide earlier than the soil with a lower pH value. The germination of bean seeds irrespective of soil types exhibited various patterns of abnormalities characteristic of the compound 2,4-D. It was also noted that there was total failure of

emergence of normal seedlings in soils treated with 2,4-D for the first 4 weeks but thereafter the emergence of normal seedlings was gradual in sandy soils while it was abrupt in clayey soils.

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Removal of High Acidity in Ghee

by

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Introduction: It was described in a note by the Bureau of Public Information, Government of India, that a simple process for the removal of free-fatty-acids in ghee had been worked out under the auspicies of the I. C. A. R. The method was acclaimed to be simple, involving no new or extra equipment from those used in ghee making. The loss of ghee due to removal of the acid fraction and during the processing was said to be small. The resultant product was said to be wholesome which would fetch a better price than the original high acid ghee. In order to test the method suggested in the note, experiments were conducted for the removal of high acidity in ghee. Sambasiva Rao (1949) studied several methods suitable for adoption by the housewife for preparing good ghee from butter and found that preservation under butter milk was the best He also describes a method for renovation of bad smelling rancid ghee, by boiling it with banana slices. This treatment seems to have given a ghee passable in flavour and taste.

Materials and Methods: The ghee samples were prepared as follows: Ghee was melted at about 70°C. when powdered lime of good quality was sprinkled on it at the rate of 3 per cent of the total quantity of ghee taken. The mixture was then well stirred and heated rapidly to 102°C. It was then filtered by passing it through a filter cloth over a funnel.

Two sets of treatments were made on ghee and coconut oil, one in the laboratory of the Government Agricultural Chemist and the other in the College Dairy as per details given below:

Treatments.

(A) Treated in the College Dairy:

	Nature of sample	Treatments
1.	Good quality ghee prepared in the College Dairy, from buffalo butter	Not treated (control 1)
2.	Poor quality ghee (purchased)	,, (,, 2)
3.	Poor quality ghee (same as 2)	Plus 3% CaO pure
4.	Poor quality ghee (same as 2)	Plus 3% local lime (impure)
5.	Poor quality ghee (same as 2) blended with 25% good quality ghee (sample No. 1)	Plus 3% local lime (impure)
6.	Coconut oil	Not treated (control)
7.	Coconut oil (Same as 6)	Plus 3% local lime (impure)

(B) Treated in the Laboratory :

	Nature of sample	Treatments
1 (a)	Good quality ghee prepared in the laboratory from butter obtained from the Coimbatore Co-operative Milk Supply Union	Not treated (control 1)
2 (a)	Poor quality ghee purchased	Not treated (control 2)
3 (a)	Poor quality ghee (sample No. 2 a)	Plus 3% CaO pure
4 (a)	Poor quality ghee (sample No. 2 a) blended with 50% good quality ghee (sample No. 1 a)	Plus 3% CaO pure
5 (a)	Coconut oil	Not treated (control)
6 (a)	Coconut oil (same as sample No. 5 a)	Plus 3% CaO pure

Each set was divided into two thus making four lots. Two lots, one of each set, were preserved in the College Dairy for observation by the Dairy Manager for flavour, aroma, body texture, colour and feel. The other two lots were preserved in the laboratory and were analysed thrice, (1) immediately after treatment; (2) three months after and (3) eight months after treatment for acidity and rancidity. Throughout the period of storage the samples were kept shut off from light but had access to air, as the mouth of the bottles were kept covered with muslin cloth. Frying tests were also carried out with the samples at the end.

Methods of Analysis: Acid value was determined by the standard method given in A. O. A. C. Rancidity was determined by Issoglios' method which consists in distilling in a current of steam a weighed quantity of oil or fat mixed with a measured quantity of water and titrating the distillate with N/100 potassium permanganate solution.

Experimental Results: The results of the experiments are presented in Tables I and II.

Discussion: Since the acid value is a measure of free fatty acids present in the sample and does not always run parallel with the production of rancidity and the determination of acid value may not always indicate the fact that a sample is not sound, rancidity was estimated in the samples by means of the "oxidisability value" i. e. the amount of oxygen consumed under standard conditions by the aldehydes and other products of rancidity after distillation in a current of steam.

It is seen from the data presented in the tables, that there is considerable difference between the two sets, the one treated in the laboratory and the other in the College Dairy. Both acidity and rancidity increase progressively with time in the case of samples treated in the laboratory, whereas there is a definite decrease in rancidity values in the second round with very slow increase in acidity in the case of those treated in the Dairy. It was ascertained from the Dairy that the samples were filtered through muslin after lime treatment which permitted a considerable portion of lime to pass through and remain at the bottom of the samples. On the other hand the laboratory samples were filtered through Whatman's No. 3 filter paper which allowed no lime to pass through. The presence of excess of free lime in Dairy samples was confirmed at the end of the eighth month by qualitative tests, wereas no free lime was found in the laboratory samples. No doubt the presence of free lime was responsible for differences in the data obtained in the analyses of the two samples since the acids produced in ghee and oil would combine with the free lime very slowly at room temperature and this is the reason for the differences in the values.

As regards the samples prepared in this laboratory, it is seen that liming has definitly retarded the development of acidity even upto eight months but it has not retarded the increase of rancidity in both ghee and oil samples as indicated by the results obtained in the third round of analysis.

It was seen that in spite of favourable analytical indications, especially in point of acidity, the treated as well as untreated samples have all become definitely bad and unfit for consumption in point of taste and aroma. When heated they all emitted a very objectionable odour. The treated samples had in addition acquired a pronounced limey taste and flavour even from the very beginning.

It may be stated that while the treatment of ghee with lime retards the development of acidity upto eight months and rancidity upto three months; the treatment does not improve the product in point of taste and aroma. In the case of coconut oil the treatment could be said to have improved the initial samples, besides slowing down the rate of deterioration and thereby increasing the marketable period. The lime treatment resulted in a smoking ghee, which gave a burnt taste to fried things.

Summary: The treatments with chemically pure as well as local quicklime improved the colour, but the flavour and aroma were

almost completely lost in samples prepared at the Dairy, though an improvement in flavour and aroma was noticed in the samples prepared in the laboratory. In both the samples the smell of lime was persistant.

In both the above sets in the treated samples no perceptible deterioration occurred during the first two months of storage whereas the untreated control as well as the standard good quality ghee deteriorated all round.

The deterioration was more rapid at the end of three months, the rate being faster in the bazaar ghee used as control. The rate of deterioration and the final product in the case of quality ghee compare favourably with all the treated samples and is in no way inferior.

The treatment with lime tended to produce smoking ghee giving a burnt taste to fried things.

The treatment of ghee with lime did not improve the quality of ghee, in point of taste and aroma.

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STATEMENT I

Removal of High Acidity in Ghee and Coconut Oil—Observations on Samples Prepared at the Diary

	SAMPLES							
	I	II	III	IV	V	VI	VII	
	Good quality ghee	Poor quality bazaar ghee	Poor quality ghee treated with 3% CaO pure	Poor quality ghee treated with local lime	Poor quality plus 50% good ghee treated with 3% lime	Coconut oil bazaar sample	Same as VI treated with 3% lime	Remarks
At commencement	Good	Poor	Colour and taste good	Slightly inferior to sample III	Same as sample IV	Good flavour and taste	Slightly better than sample VI	
Third month	Rapid loss of quality	Rapid deterioration	Rapid deteriora- except colour	Very rapid deterioration set in. Loss in taste	Very rapid deterioration. Taste bad	Very rapid deterioration. Bad taste	Rapid loss in flavour, aroma and taste	Deterioration set in
Eighth month	Very rapid loss in taste, body and aroama. Alcoholic taste	Badly deteriorated. Very bad smell	Rapid fall in taste, flavour and aroma bad	Gradual deterioration Rancid smell	Rapid deterioration. Very bad flavour and aroma	Badly deteriorated. Very bad rancid smell	Not so rapid loss. Moderate all round	Fall in quality
Frying quality	Good frying ghee. Non-smoking. Taste good	Good frying non-smoking but fried stuff bad smell	Slightly smoking ghee. Non-charring	Ghee smoking, charring and burnt taste	Ghee smoking, charring and burnt taste	Frying slow. Good white non-charred stuff obtained. Taste poor	Good frying Taste better than sample VI	Not good for domestic use

TABLE I

Showing the Development of Acidity and Rancidity in the Samples of Ghee and Coconut Oil After Treatment in Laboratory Samples

No.	Nature of Sample	Treatment	First Round		Second Round		Third Round	
			(a)	(b)	(a)	(b)	(a)	(b)
1 a.	Good quality ghee prepared in the laboratory from butter obtained from the Co-operative Milk Supply Union ..	Not treated	0·423	3·2	0·606	2·4	0·747	4·0
2 a.	Poor quality ghee (purchased) ..	Not treated	0·959	2·8	1·440	6·4	1·847	9·6
3 a.	Poor quality ghee (sample 2a) ..	Plus 3% CaO pure	0·014	3·2	0·127	3·2	0·367	15·2
4 a.	Poor quality ghee (sample 2a) blended with 50% good quality ghee (sample 1a) ..	Plus 3% CaO pure	0·014	2·4	0·042	4·4	0·169	8·4
5 a.	Coconut oil ..	Not treated	1·311	6·0	2·143	1·6	2·509	4·0
6 a.	Coconut oil ..	Plus 3% CaO pure	0·606	4·0	0·888	0·8	1·255	18·4

Note: (a) Acidity Oleic acid %; (b) Rancidity Mgm. Oxygen.

TABLE II

Showing the Development of Acidity and Rancidity in Ghee and Coconut Oil After Treatment in Dairy Sample

No.	Nature of Sample	Treatment	First Round		Second Round		Third Round	
			Acidity as Oleic acid %	Rancidity Mgm. Oxygen	Acidity Oleic acid %	Rancidity Mgm. Oxygen	Acidity Oleic acid %	Rancidity Mgm. oxygen
1.	Good quality ghee prepared in Dairy from buffalo butter ..	Not treated	0·367	6·0	0·409	2·0	0·564	3·6
2.	Poor quality ghee (purchased) ..	Not treated	1·213	3·6	1·255	1·0	1·480	5·2
3.	Poor quality ghee (sample 2) ..	Plus 3% pure CaO	0·042	4·4	0·085	2·4	0·113	8·0
4.	Poor quality ghee (sample 2) ..	Plus 3% local lime	0·085	5·6	0·141	1·6	0·141	6·8
5.	Poor quality ghee (sample 2) blended with 25% good quality ghee (sample 1) ..	Plus 3% local lime	0·014	2·4	0·141	0·8	0·169	4·0
6.	Coconut oil ..	Not treated	2·130	4·8	2·214	3·2	2·721	3·6
7.	Coconut oil ..	Plus 3% local lime	0·522	5·6	0·254	3·2	0·268	12·4

Use of Antibiotics in Plant Disease Control — A Review

by

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Introduction: Ever since Alexander Fleming reported on the bacteriostatic and bactericidal activity of *Penicillium notatum* in the year 1929, the study of antibiosis and antibiotic substances has advanced to a great extent and more than one hundred antibiotics have so far been isolated from various micro-organisms. Waksman (1947) clarified the confusion regarding the use of the word 'antibiotic' and defined it as, '*a chemical substance, produced by micro-organisms, which has the capacity to inhibit the growth of and even to destroy bacteria and other micro organisms*'. Most of the antibiotics isolated were tested for their use in medical science and a few of them like Penicillin, Streptomycin, Aureomycin and Terramycin have come into extensive use as chemotherapeutic agents. The use of antibiotic substances in agriculture, especially against plant diseases, is being worked out in different countries and some encouraging results have been reported.

Use against plant diseases: The possible uses of antibiotic substances in plant disease control, as understood at present, are briefly reviewed below :

(i) Control of soil-borne fungal pathogens is one of the serious problems confronting plant pathologists throughout the world and earlier workers have attempted to make use of the phenomenon of antibiosis in checking soil-borne diseases. As early as 1908 Potter stated that *Pseudomonas destructans*, the cause of rot of turnips, could be controlled by spraying a toxin produced by the bacterium in an artificial medium. Sanford and Broadfoot (1931) observed that the pathogenicity of *Ophiobolus graminis*, causing the "take-all" disease of wheat, could be checked by the culture filtrates of *Actinomyces* sp. and *Penicillium* sp. Tims (1931) obtained a certain amount of reduction in the infection of sugarcane by *Pythium arrhenomanes* when the soil was inoculated with some actinomycetes. Russian investigators (Chudiakov 1935, Novogrudsky 1936, Berezova 1939, Nanmova 1939) have suggested 'bacterization' as a means of protection against plant pathogenic fungi. The susceptibility of the seedlings to infection was stated to be reduced

by treating the seeds with specific bacteria before sowing. Anwar (1949) was able to check the incidence of flax wilt caused by *Helminthosporium sativum* by adding metabolic products of certain soil micro-organisms. Unfortunately the studies made in recent years have shown that most of the antibiotics when added to the soil lose their activity for various reasons, thus making it unreliable to apply antibiotics to the soil for controlling plant pathogens. Intensive research is going on in leading laboratories of the world to overcome this defect and the recent publication of Wright (1952), stating that *Trichoderma viride* is capable of producing Gliotoxin in non-sterile but acid soil to which one per cent clover was added, is somewhat encouraging.

(ii) Solutions of antibiotics can be sprayed on plants as a preventive measure against air-borne diseases. Vander Laan (1947) found that Clavacin, an antibiotic produced by *Aspergillus clavatus*, could be sprayed on plants to prevent fungal infection. Felber and Hamner (1948) reported that the antibiotic Actidione, isolated from *Streptomyces griseus*, when sprayed on Red Kidney beans against *Erysiphe polygoni*, the mildew completely disappeared after 48 hours. Peterson and Cation (1950) and McClure (1952) could successfully eradicate *Coccomyces hiemalis* causing leaf spot of cherry by spraying Actidione. Gregory *et al* (1952) were able to control damping-off of alfalfa seedlings by spraying Actidione. Leben and Keitt (1952) found that Helixin, an antibiotic produced by *Streptomyces* sp., was effective in controlling early blight of tomato when sprayed at a concentration of 6·5 mgm./ml. Murneck (1952) found that spraying Thiolutin, an antibiotic from *Streptomyces albus*, reduced infection by *Erwinio carotovora*, the fire blight organism affecting fruit trees.

(iii) Antibiotics can be fed to plants through roots or through leaves so that they may act as systemic fungicides and prevent infection of the plants by fungi and bacteria. Repert and Hawas (1951) demonstrated the inhibitory action of Penitalin isolated from *Penicillium italicum*, on the development of galls in fruit trees due to *Bacterium tumefaciens*. Blanchard (1951) found that galls caused by *B. tumefaciens* on tomato plants were very few when the plants were grown in a solution of Aureomycin. Brian *et al* (1951) have demonstrated that Griseofulvin, an antibiotic obtained from *Penicillium nigrum*, acted as a systemic fungicide and prevented infection by *Botrytis cinerea* on lettuce and *Alternaria solani* on tomato. Brian (1952) reported that Gliotoxin, another

antibiotic obtained from *Trichoderma virede*, acted as a systemic fungicide in tomato plants and checked infection by *A. solani.* Gopalakrishnan and Jump (1952) found evidence for the systemic activity of Thiolutin in tomato plants against infection by *Fusarium oxysporum* var. *lycopersici*. The author in his studies with a new antibiotic produced by *Bacillus subtilis* found that it acted systemically in tomato plants when fed through roots and checked infection of the leaves by *A. solani.*

(iv) Internally and externally seed-borne diseases can be easily controlled by soaking the seed material in antibiotic solutions which can diffuse through the tissues and kill the pathogen. Timonin (1946) reported complete inhibition of germination of spores of *Ustilago tritici*, the fungus causing loose smut of wheat, in Patulin solution and claimed that diffusion of the antibiotic took place in wheat seeds. Wallen and Skolko (1950) found that internal infection of pea seeds, affected with *Ascochyta pisi* was effectively controlled by antibiotic XG, isolated from *Bacillus subtilis.*

(v) So far no satisfactory remedial method has been found out for the virus diseases of plants. In recent years some of the plant viruses are reported to be inhibited by antibiotic preparations and so with the advance of our knowledge and experience with antibiotics we may be able to control some of the serious virus diseases of plants. Ramon *et al* (1948) found that an antibiotic preparation obtained from *B. subtilis* exerted a marked neutralising action on tobacco necrosis virus. Gupta and Price (1952) have shown that the growth products of *Trichothecium roseum* exhibited an inhibitory action on plant viruses, which was demonstrated to be due to change in the host susceptibility rather than action *in vitro.* Leben and Fulton (1952) reported that the antibiotic Streptomycin inactivated tobacco necrosis virus *in vitro* and Terramycin prevented multiplication of tobacco mosaic virus. Stassel *et al* (1953) found that Toximycin, obtained from *B. subtilis,* inactivated tobacco mosaic virus *in vitro.* The author in his studies also found that, infection by the viruses of *Petunia* mosaic, Chilli mosaic and *Vinca rosea* mosaic was inhibited by an antibiotic isolated from *B. subtilis.* The inhibition was found to be due to direct action of the antibiotic on the virus *in vitro* rather than any change brought about on the host tissue. These results clearly show that by using antibiotics as systemic agents or as preventive sprays, the infection of the plants by viruses can be prevented.

(vi) Some of the antibiotics like Terramycin are reported to induce growth in plants and animals. Such antibiotics can be made use of in inducing more vigour in plants to withstand or escape the disease.

Discussion: Thus there is sufficient evidence to show that antibiotics can be widely used in plant disease control. There seems to be however, some shortcomings in putting them into practical use: (a) Some of the antibiotics are reported to be toxic to plants and in some cases they are known to affect the germinability of seeds, (b) most of the antibiotics lose their activity when added to the soil and in other cases they are thermolabile thus making it difficult to use them in agriculture, (c) in the case of the antibiotics which act systemically in plants, there is evidence of their activity being reduced or lost after a short period which creates additional trouble in putting them into use.

These shortcomings do not detract from the potentiality of these agents for controlling plant diseases. If anything, similar toxicity and other defects observed in putting them into use in human beings have led in the past to more intensive searches for better antibiotics. Besides these, the high cost of antibiotics makes one feel that it is impossible to use them in agriculture. It has been pointed out that the cost of penicillin, which was so high a few years back, has been brought down to such a low level that at present it costs less than that of the container in which it is packed. So it is hoped that with the quick advancement of science and our knowledge in antibiotics, these defects will be easily overcome and it won't be long before these substances come into extensive use in controlling plant diseases.

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Nitrogen in Paddy Soils

by

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Green manures are perhaps the most self-supporting manures in the tropics and are often claimed to be quite as effecient as Ammonium sulphate in rice production. This is of course, not surprising, seeing that they contain nearly 3–4% of nitrogen on dry weight basis, and a carbon/nitrogen ratio of about 10.

The leafy portion in green manures is naturally richer in nitrogen content than the stems and the decomposition may be noted in two stages, with the leaves figuring in the first stage and stems in the second. Thus green manures serve as a mixture of a quickly efficacious, concentrated nitrogenous fertiliser similar to ammonium sulphate and a more slowly-acting manure similar to compost or cattle manure.

The practice of green manuring is common both in garden lands and in wetlands, but in the former certain precautions are necessary, because with the large quantities of readily decomposed carbohydrate material, there is a possibility of the soil nitrogen getting impoverished. That is why in tea and coffee plantations, green manure applications are always accompanied by liberal doses of amonium-sulphate.

In wetlands, the conditions are different. Though green-manuring is well-known as a very beneficial practice in rice culture, how exactly this beneficial response is brought about is still not settled. If a cross section of paddy field soil is taken it will be seen that only the top half to one inch layer is under aerobic condition and all the lower portion is under anaerobic conditions. The question therefore arises as to the nature of the decomposition of the proteins in the green manures applied. From their classical experiments in 1913 to 1916 in the early days of the Agricultural Department, Harrison and Subramania Ayyar were led to conclude that green manures had little or direct manurial value; and as the rice crop depended primarily on the nitrogen for its growth, green manures were useful only in an indirect manner, by helping to improve the soil aeration.

Joachim and Kandiah working in Ceylon, obtained supporting evidence for this indirect effect, but they found that there was

also a direct effect, by minimising loss of soil nitrogen and improving plant growth thereby.

This problem has also attracted the attention of Japanese workers; but they held the view that nitrogen fixation by blue-green algae was an important factor in flooded rice fields. In fact some even claimed that one of the causes of the relatively high level of fertility of Japanese paddy fields, was attributable to nitrogen fixation by blue-green algae.

Here again, though the fact was well recognised, the actual mechanism involved is still a matter of discussion. Thus P. K. De in Bengal claimed to have proved that the algae themselves are responsible for nitrogen fixation while other workers (Choudhuri, 1940) hold that this function is attributable not to the algae. This divergence of views is unfortunately not an easily resolvable one, on account of the practical difficulty in isolating pure cultures of uncontaminated blue green algae, as they are usually covered with a gelatinous sheath wherein bacteria like *Azotobacter* can survive. The task of separating the bacteria from the sheaths is a difficult one.

Japanese workers have on the other hand, attempted to isolate algal cultures with high nitrogen-fixing ability and studied the inter-relations between the degree of nitrogen fixation by algae to other environmental factors like fertilising. In 1941 Watanabe collected over 600 soils from tropical paddy fields and from them isolated ten species of blue-green algae. Out of these ten, three species were claimed to have a high power of fixing atmospheric nitrogen, viz. *Tolypothrix tenuis* from Borneo, *Calothrix orevissima* from Parao and *Arabaenopsis* sp. from Sumatra.

Attempts have also been made in Japan (Konishi, 1951) to see the effect of artificial inoculation of Japanese rice fields by tropical blue green algae. A significant effect was perceptible after inoculation, in plots which had also been limed, but not otherwise, indicating that the soil reaction (pH. value) played a decisive role in determining the degree of algal effect. Whether the practice would prove to be an economic proposition has not, however been determined so far.

Denitrification under water-logged conditions: The surface water of a flooded rice field gets sufficient oxygen from the atmosphere and also from the photosynthetic action of hydrophytes like blue-green algae. This oxygen has an influence only on the uppermost

layer, extending to not more than one inch at the most. Below this "aerobic" or "oxidised" layer there is a much larger "reduced" layer where micro-organisms live under anaerobic conditions. This reduced layer constitutes the main portion of the paddy soil, and under the anaerobic conditions existing here, the question is still open whether the paddy plant utilises nitrogen in the form of ammonia. Experiments in Japan and also at Cuttack, with placement of fertilisers like ammonium sulphate have shown that placement arrests the oxidation of ammonia to the easily leachable from of nitric-nitrogen. If the paddy plant is capable of utilising ammonia, there must be some form of ammoniacal nitrogen detectable under paddy field conditions. So far experiments by various workers and in particular the latest investigations carried out at Coimbatore have indicated only the presence of soluble proteins. So that the questions as to the form in which the paddy plant absobs and utilises its nitrogen requirement, still remains unsolved, awaiting further investigation for its elucidation.

CROP AND TRADE REPORTS

Crop Statistics—1953—'54—Madras State. Groundnut Final Forecast: The area sown in the Madras State upto 25th December 1953 is estimated at 1,872,000 acres evealing an increase of 1·1% over last year and 2·2% over the average area calculated for the five years ending with 1951—'52. The increase in area this year is due mainly to timely rains at the time of sowings. The yield per acre is expected to be normal in the districts of Salem, Tiruchirapalli and Tanjore and slightly below the normal in all the other districts of the State. The seasonal factor for the State as a whole works out to 96 percent of the normal as against 75 percent of the normal estimated for the corresponding period of the previous year. On this basis, the total yield is expected to be 902,600 tons of unshelled nuts representing an increase of 30·5%. The average wholesale price (machine shelled) per maund of 82–2/7 lb. or 3,200 tolas as reported from important market centres on 9th January 1954 reveal an increase of 22·2 percent in Erode, 10·8 percent in Vellore, 7·6% in Salem, 7·9% in Cuddalore and 4·4% in Coimbatore.

Gingelly—Third Forecast: The area sown in the Madras State upto 25th December 1953 is estimated at 3,46,000 acres an increase of 10·8% percent over the five year average. The main crop has been harvested. The yield per acre is expected to be normal in Salem district and slightly below the normal in all the other districts of the State. The seasonal factor for the State as a whole works out to 95 percent of the normal as against 79 percent of the normal in the corresponding period of last year. On this basis, the total yield is estimated at 43,200 tons revealing an increase of 33·7% over last year and 31·3% over the five years average. The average wholesale price of gingelly seed per maund of 82-2/7 lb. as reported from important market centres on 9th January 1954 reveals a decrease of 17·2 percent in Tiruchirapalli and 15·2 percent in Tirunelveli. (Director of Statistics, Madras).

EXTRACTS AND GLEANINGS

The Indian Bristle Trade: It may not be known to all that India is an important source of pig bristles for the brush manufacturing industry. The main raw material in the making of brushes comes from the bristles obtained from the back of the neck on pigs. In Great Britain though pigs are reared in large numbers; they are not useful for obtaining the bristles required by the brush ware industry, because long and intensive breeding for early maturity and pork quality has evolved an animal with a fine, short and scanty coat of hair. Hence the chief bristle-producing countries were Russia and Poland in Europe and China and India on the Asian continent, up to the first quarter of the present century. Since then supplies have dwindled from Poland and Russia while China has advanced to the forefront as the principal supplier. India continues to be the second best country for suppling pig bristles.

The total pig population of India is estimated at about 3·71 lakhs, in the Uttar Pradesh, Madras and Bihar as the leading States in this respect. The seasonal output of bristles is valued at over a crore of rupees; the quantity exported per year varying from 3,600 to 4,900 cwts. Bulk for bulk it is a fairly expensive commodity the present price being about Rs. 10/-. per lb. after being stabilised by the Government of India, the peak being Rs. 25/- per lb. in 1951 due to the short supply from China owing to the Korean War and stockpiling.

At the present moment, China seems to be the only country which is a serious rival to India's bristle trade. Since quality is the keystone of every export structure, efforts should be concentrated to standardise and maintain rigidly definite quality grades in order to retain the goodwill of buyers abroad. Of late there have been complaints (as in many other items in India's export-trade) regarding the wide range of variations in quality and high percentage of adulteration in Indian bristle consignments. Since few commodities offer greater scope for deception the Government of India have passed the Bristles Grading and Marketing Act in 1950 to safeguard the export trade in bristles but sufficient steps have not been taken so far to ensure a thorough check on the processes bristles have to be put through, from the time of its picking till its shipping such as disinfecting, boiling, straightening, grading, dressing and packing. The colours that are preferred are white or black, grey being the least preferred. In India, however, grey is the predominent colour in most cases. The length varies from 2 inches (known as shorts) to 7 inches or longer, the latter naturally fetch a much better price.

Provided India is able to maintain adequate quality control and standardisation of grades, there is no reason why we should lose our present favourable position in the international bristle market even after the United States of America withdraws its import restrictions on Chinese bristles. (T. R. N.)

* * * *

Phosphate relationships of Soil and Plant — III. Forms of P., in the Brannalt limed and unlimed podzol series — By Sante Maltron, Emlyn, G. Williams and Eugen Barkoff — pp. 107–120 (Annals of the Royal Agricultural College of Sweden, Vol. 17–Uppsala 1950.)

The following forms of P., have been studied in the Brannalt profile series, including the excessively limed soil in the field and the unlimed virgin podzol under a stone fence:— (1) Acid oxalate — soluble P., (2) 0·2 N. $H_2 S 0_4$ — soluble· (3) Organic. (4) 2·5% acetic acid soluble. P. (5) Neutral 0·5 N. $N H_4 F$ soluble P. (6) Lactate–soluuble P.

The fluoride liberated, acid soluble, beta-humus has also been determined and found to be formed in considerable quantities in the limed profiles as a product of autoxidation. The beta-humus precipitates in the upper beta horizon where it displaces the phosphate which is pushed deeper down into the lower beta horizon.

* * * *

Phosphate relationships of Soil and Plant - IV Forms of P. in the Hydrologic soil series of the Dala brown earth and the unden Podzol — By Santi Maltron, Eugen Barboff and Emlyn G. Williams. ibid. 1950 pp. 120—129.

This is a report on the distribution in these profile series of some of the forms of P., (as the sulphuric acid-soluble P., organic P. etc.) discussed in the proceeding paper on the Brannault series.

Phosphate relationships of Soil and Plant — V. Forms of P., in the Lanna soil By Sante Maltron, Emlyn, G. Williams, Elisabeth Koutler — Andersson and Eugen Barkoff — pp. 130–140; ibid 1950.

The parent material of the Lanna soil possesses a high base status and is rich in P., most of which is Ca-bound. Due to impeded drainage the lower subsoil is only slightly leached and has an alkaline reaction and a high P., content.

The top soil and the upper subsoil is acid and is low in inorganic P., all of which is sesquioxide-bound. The organic P., is relatively high in the top soil.

Liming the soil has apparently stimulated the decomposition of the organic P., compounds. Compared to the unlimed plots the limed plots possess a greater content of all forms of inorganic P.

* * * *

Phosphate relationships of Soil and Plant — VI. The salt effect on phosphate solubility in Pedalfer soils — Sante Maltson, Egil Abosaker, Elisabeth Koutler — Andersson, Eugen Barkoff and Karel Vahtras — pp. 141–160; ibid 1950.

The effect of neutral salts on solubility in pedalfer soils is of two kinds. 1. Displacement of the phosphate ions by the anions of the salt resulting in a greater solubility. This reaction depends on the basoid content and dominates at low pH. 2. Suppression of the Donnan distribution of the ions, resulting in a greater adsorption. This reaction depends on the acidoid content and dominates at higher pH. The point of zero salt effect depends on the acidoid basoid ratio and on the valence of the anions of the salt.

* * * *

Phosphate relationship of Soil and Plant VII. Forms of P., in the Marste hydrologic clay series — By Sante Mattson, Erik Eriksson, Elisabeth Koutler — Anderson, Eugen Barkoff, Sten Stahlberg and Karel Vahtrass; pp. 222-246 ibid 1950.

The paper is a report on the pH and the distribution of Cl, SO_4 $CaCO_3$ and different forms of PO_4 in the Marite hydrologic clay profile series. The profiles cover a stretch of nearly 600 meters and a difference in elevation of 3·6 meters. The lower or "wet end" profile extends through a layer of 10 meters of post glacial, varved clay. The intermediate profile cover both forms of clay. The top soil of the dry end contains $CaCO_3$ and is rich in PO_4 mostly soluble in weak acids. The top soil of wet end is acid and poor in PO4 mostly insoluble in weak acids. (I. R. & A. M. K.)

Weather Review — For the month of February, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total for the month	Departure from normal	Total since 1st January	Division	Station	Total for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	0·0	— 0·4	2·7	South	Madurai	0·1	— 0·4	3·5
	Tirurkuppam*	0·0	— 0·5	3·1		Pamban	0·0	— 0·9	2·7
	Vellore	0·0	— 0·3	2·3		Koilpatti*	0·0	— 1·3	4·4
	Gudiyatham*	0·0	— 0·2	2·0		Palayamcottai	0·0	— 1·2	3·3
						Ambasamudram*	1 0	— 0·8	8·7
East Coast	Palur*	0·6	+ 0·2	3·3	West Coast	Trivandrum	1·6	+ 0·8	3·7
	Tindivanam*	0·0	— 0·3	3·0		Fort Cochin	0·0	— 0·8	1·5
	Cuddalore	0·9	— 0·0	6·1		Kozhikode	0·0	— 0·7	0·2
	Nagapattinam	0·1	— 0·7	4·0		Pattambi*	0·0	— 0·8	0·0
	Aduturai*	£	— 0·8	2·7		Taliparamba*	0·0	— 0·1	0·5
	Pattukottai*	0·1	— 0·8	4·3		Wynaad*	..	..	..
						Nileshwar*	0·0	£	0·3
						Pilicode*	0·0	— 0·1	0·2
Central	Salem	0·0	— 0·3	1·0		Mangalore	0·0	— 0·2	0·3
	Coimbatore (A. M. O.)*	£	— 0·2	3·4		Kankanady*	0·0	— 0·1	0·4
	Coimbatore	0·0	— 0·4	3·5	Hills	Kodaikanal	0·0	— 1·5	6·8
	Tiruchirappalli	0·0	— 0·3	1·8		Coonoor*	1·8	— 1·3	10·2
						Ootacamund*	0·5	— £	2·4
						Nanjanad*	0·3	— 0·3	2·1

Note:—1. * Meteorological Stations of the Madras Agric. Dept. 2. £ Rain-fall 1 to 4 cents.

A low pressure wave was moving westwards across the extreme South-west Bay of Bengal on 1 - 2 - 1954, which moved over the Ceylon—Comorin area on the next day and passed away west-wards across the Maldives area on the third day. This was quickly followed by another low pressure wave on 4 - 2 - 1954 on the same track. After a lull for six days another low pressure wave moved westwards across Ceylon—Comorin area on 12 - 2 - 1954. On 20 - 2 - 1954 a low pressure wave moved westwards across the same area as the previous one and passed away across the Maldives on the very next day. A low pressure wave was moving westwards across the South-west Bay of Bengal on 23 - 2 - 1954 but this became unimportant in two days. On 26 - 2 - 1954 also a low pressure wave moved westwards across the Comorin area closely followed by another low pressure wave on 28 - 2 - 1954.

A series of eight Western Disturbances, with their associated Secondaries passed over the North-west and North India during this month. Generally dry weather prevailed over the Madras State, except for scattered showers in coastal Tamil Nad on 1 - 2 - 1954 and in interior Tamil Nad on 27 - 2 - 1954. Day temperatures were high during the second half of the month. Palghat recorded the highest maximum temperature of 102°F., on 14 - 2 - 1954. The only note-worthy rainfall during the month was 1·54″ recorded on 27 - 2 - 1954 at Sim's Park, Coonoor. Details of the zonal rainfall in inches for the month are furnished hereunder.

S. No.	Name of zone		Average for the month	Departure from normal	Remarks
1.	North	..	0·00	— 0·35	Below normal
2.	East Coast	..	0·48	— 0·40	,,
3.	Central	..	0·01	— 0·30	,,
4.	South	..	0·22	— 0·92	Far below normal
5.	West Coast	..	0·16	— 0·22	Below normal
6.	Hills	..	0·65	— 0·78	,,

Agricultural Meteorology Section
Lawley Road P. O.,
Coimbatore, 13—3—1954.

C. B. M. & M. V. J.

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THE MADRAS AGRICULTURAL JOURNAL

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All articles for publication should be addressed to the Editor, Madras Agricultural Journal, Lawely Road P. O., Coimbatore. In view of the high cost of printing contributions should be as concise as possible and should conform to the best usage in the leading Journals published in India and abroad.

Manuscripts should be typed with double spacing on one side of the paper only and with wide margin. They should not ordinarily exceed 3,000 words or 8 pages of printed matter including tables and illustrations in the Journal. Manuscripts should be carefully revised; numerical data and calculation checked. Main headings in the text should be typed in capitals with paragraph indentations and followed by a period and two hyphens. Sub-heads should be lower case and be underlined to indicate italics. Latin nomenclatures and local terms etc., should be in italics. Original papers must conclude with a summary of not more than 300 words drawing attention to the main facts and conclusions.

Tables: The number of tables should be restricted to those absolutely necessary, as numerous tables detract from the readability of the article. Each table should numbered consecutively from 1 up and must have a heading stating its contents clearly and concisely. The tables are to be typed on separate sheets, with their positions marked in the text.

Illustrations: Wherever possible illustrations should be made with pen and Indian ink for reproduction as line blocks. The name of the author, title of the article and figure number should be written on the back of each figure in blacklead pencil. Each figure should have a legend typed on a separate sheet.

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The Madras Agricultural Journal

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Editorial

There has been for quite a long time a controversy over the utility and place of fundamental research in science in institutions of applied research. This is no where, so vehemently argued upon as in the Agricultural Research Institutes of India. The Egerton Committee which reviewed the work of the National Laboratories of India has made several comprehensive recommendations. One of its recommendations deals with the fundamental research. It points out that fundamental research (researches conducted to gain knowledge) has led almost always to new applications and that it is wise not to tie the research programmes of an institute too completely to purely practical problems but to encourage fundamental work being done along with researches of more immediate application. Biological sciences can never be reduced to the level of mathematical formulae or mechanical accuracy as in the mathematical and other sciences. Too much stress on the practical side may stultify the view as in Russia where it has ended in mere campaign against Mendelian and Neo-mendelian theories, though their basic principles are being applied daily in hybridisation and selection. It is difficult at anytime to draw a line where any research remains fundamental and where it becomes practical. The study of algae is admittedly of no use in practical agriculture of crop plants. Yet, today the role played by some of the algae found in the paddy fields has become a problem of applied science. Similarly the application of a number of ready made manures, weedicides, fungicides and pesticides has become easy and it appears as though, that no more study on them is necessary, yet it is here that more fundamental research is urgent. Though agriculture is practiced successfully by an ordinary farmer, agricultural science is one of the most complex problems known to man. It is in these biological sciences like agriculture and medicine that utmost team work is necessary. A lone worker is not of much use. All agricultural workers should align themselves to a set programme of team

work in order to achieve sound results. In this connection the Egerton committee has suggested that the Council of Scientific and Industrial Research should be the co-ordinator. The committee has also stressed the advantages of free communication and exchange of views between workers, the encouragement of training of post graduate students, the undertaking of lectures at post graduate level by research workers at university centres and the importance of the university teachers and workers visiting the research centres so that right sort of workers might be turned out of these teaching centres and not the least the freedom for the research worker, time and financial help for the research institutes. In this connection it has called upon private firms to organise research centres not only to serve their own needs but also that of the nation at large through promoting fundamental research. The knowledge of a biological system whether it be plant, animal or human being is of vital necessity before any lasting research work can be done on them and therefore it is of great importance that fundamental research should be given due encouragement.

Cultivation Practices in Sandy Soils of Bapatla

by

SRI I. SAMBASIVA RAO

Assistant Lecturer in Agriculture, College of Agriculture, Bapatla

Bapatla, in Guntur district, is a small town on the East Coast, situated on the North-East line of the Southern Railway, five miles away from the sea. A strip of land about six miles in width along the coast is sandy in nature. The soils under continuous cultivation, adjoining the villages, have accumulated some organic matter. The water table is high, being four to six feet deep and in the rainy season it is very near the surface at two feet depth. In summer it may go down to eight to ten feet. The water is slightly brackish, but not injurious to crops. The soils are not fertile, but under irrigation respond well to manuring, organic and inorganic. The high water table is taken advantage of for the cultivation of crops in a large-scale sand culture. Temporary wells called "doruvus" are dug and water is taken from the "doruvus" with earthen pots for splash watering. (Vide plate 1). Cattle manure is the chief bulky manure in use, but it is always inadequate. Penning cattle and sheep is supplementary. These manures are applied only for paying crops in small areas to increase the yield. Sulphate of ammonia is used liberally for all crops, followed by profuse waterings. This is a tract where this fertiliser has been in extensive use since a long time and is locally termed as "super"

The salient features of the cultivation are regular splash watering throughout the growth period, with periodical top dressings of sulphate of ammonia, with or without basal dressings of cattle manure or sheep-penning. The cultivated area is confined to small holdings owned or leased, varying from 25 to 50 cents and intensively cultivated. The whole family works and earns a good wage throughout the years. The crops grown and the rotations followed are:

May to July—Paddy nurseries.
August to November—Virginia tobacco nurseries.
December to March—Ragi. or
December to June—Brinjal and Chilli—once in three years.

A small plot of few cents is set apart for jasmine which is retained for about ten years. Ragi and sometimes, vegetables like greens and cucurbits are also grown. Even the owner cultivators are sometimes forced to take out some land on lease. The lease ranges from eight annas to one rupee per cent.

Large holdings are few as it does not pay to hire labour and cultivate. It is also difficult to manure adequately. Hence, cultivation of rainfed crops viz. groundnut, cowpea, and horse-gram, is common. Their success depends upon the rainfall which is normally sufficient and fairly well-distributed as shown below, (Average of ten year period from 1943 to 1952):

South-West monsoon period—June to September—20·26″ on 50 days.
North-East monsoon period—October to January—11·63″ on 16 days.
Dry weather period—February to May—3·66″ on 8 days.
Total rainfall for the year—35·55 on 74 days.

Under conditions of extensive cultivation in large holdings, the following rotation is common: June—July to September—October—groundnut or cowpea; October--November to January—February—Horsegram or cowpea. Late season cropping is confined to only such lands where there is some residual fertility left i. e. after the removal of casuarina, paddy and tobacco nurseries, or where sufficient manure was applied in previous years. Otherwise, it does not pay to grow two crops in a year. Casuarina plantations and raising of virginia tobacco seedbeds are taken up even with hired labour. Casuarina comes in such lands periodically, planted in July—August and is retained for seven to ten years.

Except in rainfed crops, in all other cases, the cultivation is rather peculiar, though simple. The cultivation details of the various crops are described hereunder.

1. **Paddy Nurseries:** The wetland area of Bapatla and the adjoining villages is situated towards the west, beyond the sandy soil belt. They are irrigable under the Krishna delta system. This area is at the tail-end of the irrigation channels. As such, water is usually received late in the season. There is no other source of water in the wetlands to raise the seed beds in advance. If nurseries are raised after the receipt of water in the irrigation canals, planting will be delayed. The wetland ryots are therefore compelled to go in for the seedlings that are grown in sandy soils. Nurseries are raised with the popular varieties and often fetch remunerative returns. The areas are small, with about five to ten cents in each holding.

The plot is ploughed twice with a country plough. No basal dressing is given. In rare cases sheep are penned at 2,000 sheep per acre. Seed is sown broadcast at 12 to 15 pounds per cent. The heavy seed rate is to minimise the area, to facilitate manuring and splash watering. The seed is covered by ploughing twice and levelled with a brush harrow. Sand is sprinkled in a thin layer to cover the exposed seed, and splash-watered twice a day. On the third day after sowing, sulphate of ammonia at two pounds per cent or powdered groundnut cake at six pounds per cent—usually

the former—is applied and the plot is lightly ploughed twice. This is a peculiar practice called "*muragadammu*" in this locality. It is intended to incorporate the topdressing applied and to bring up the deep-seated ungerminated seed to the surface. Then plots are formed four feet wide with pathways in between for watering. The beds are levelled and regularly splash-watered twice a day in the mornings and evenings. A fortnight later, another topdressing is given at half the first dose, with sulphate of ammonia. If found necessary, a light third dressing is given a fortnight after the second dressing to push up the seedlings. The seedlings will be ready for planting in 40 days but can be retained up to two months. Sheep-penned plots receive very light dressings of the fertiliser. Seedlings from two to two and a half cents would be sufficient to transplant an acre and usually fetch Rs. 15/-. Sowings commence from the last week of May and continue till the end of June, and the seedlings are pulled out in July—August.

2. **Virginia Tobacco Nurseries:** The sowing season commences from August and continues up to October to lift the seedlings from October till December. The nurseries are raised, on a large scale, even with hired labour. Ryots from the adjoining places come over here and raise the seedbeds on leased lands. The lease amount varies from Rs. 60/- to Rs. 100/- per acre. Seedlings grown in sandy soils are always preferred. They do not develop the tap root and the root system is in tufts, fibrous, and shallow. They establish very quickly and thrive better when transplanted. There is always a great demand for the seedlings from the black soil tracts of Guntur and Krishna districts, where virginia tobacco is extensively cultivated. It has been paying well to grow them.

The land is ploughed twice followed by a digging with spade. Then a third ploughing is given. Beds are formed four feet wide with pathways in between. Tobacco midribs are added as manure at 5,000 pounds (20 bales) per acre and over this, cattle manure is applied at five tons per acre. The beds are dug up to incorporate the manures, and levelled. Seed is sown at one tola per cent (2½ lb. per acre), mixed with sand and the beds are compacted by trampling. The beds are again covered over with 2,500 pounds (10 bales) of tobacco midribs and 3,000 pounds of dried casuarina leaf gathered from the plantations, to serve as a mulch. The beds are lightly watered with rose cans thrice a day (if there are no rains). For watering, eight men are required, with eight "doruvus" per acre. After three weeks, the surface casuarina mulch and tobacco midribs are removed during weeding, and a top dressing of sulphate of ammonia is given at 10 lb. per acre. A second dose is given at 20 lb. per acre a fortnight after the first and a third at 40 lb. per acre a fortnight after the second. Sometimes even four top dressings

are given, reducing the interval between the successive dressings. The beds are weeded twice. Seedlings will be ready in six to eight weeks and 6000 seedlings are required to plant an acre. They can be obtained from one to one and a half cents, fetching an average return of Rs. 25/- to Rs. 30/-.

3. **Ragi**: This is a staple food crop of the working classes. The main season is December—January to March—April. The seed-beds are dug twice with spade and cattle manure applied at 10 baskets per cent (about 300 lb.), and incorporated by spading. Seed is sown at two to three pounds per cent, raked up, levelled and watered once a day. A week after sowing, half a pound per cent of sulphate of ammonia is applied and repeated a week later. The top-dressing is followed by light watering twice a day for four days. The seedlings will be ready for planting in three weeks. Seedlings older than one month are considered inferior and are usually rejected. The main field is ploughed twice, manured with cattle manure at five to ten tons per acre or sheep-penned at 1,000 to 2,000 sheep per acre covered by ploughing and levelled. In dry sand, the seedlings are planted four inches apart and immediately splash watered, and continued once a day in the morning. (vide. plate. 2). But now and then watering is stopped for a day. A week after planting, sulphate of ammonia is applied at two pounds per cent followed by watering twice a day for four days. A second top-dressing is given at half the first dose at the time of flowering. Third dressing is rare and is given only if the crop is lagging behind. The crop matures in two months after planting. Four days prior to harvest, watering is stopped. During this period, the crop turns yellow and the earheads get hardened. The earheads are harvested all at one time. They are heaped for three days, dried, threshed and cleaned. The yields vary from 1,200 to 3,000 lb. per acre. The straw is fed to cattle either green or dry. The crop grows to a height of two feet (vide. plate. 3.), but the plants do not tiller. The cultivation just pays them their wages in kind.

4. **Groundnut**: Groundnut is cultivated in large holdings in the usual manner under rainfed conditions. The crop generally succeeds a casuarina plantation. Due to the accumulation of shed leaves, the crop comes up well without any manuring. The land is ploughed twice and is sometimes manured at about five tons per acre with cattle manure or lightly penned. The usual variety grown is the bunch variety. Kernels are dibbled in plough furrows in June—July with the commencement of regular showers. Seed

Plate 1

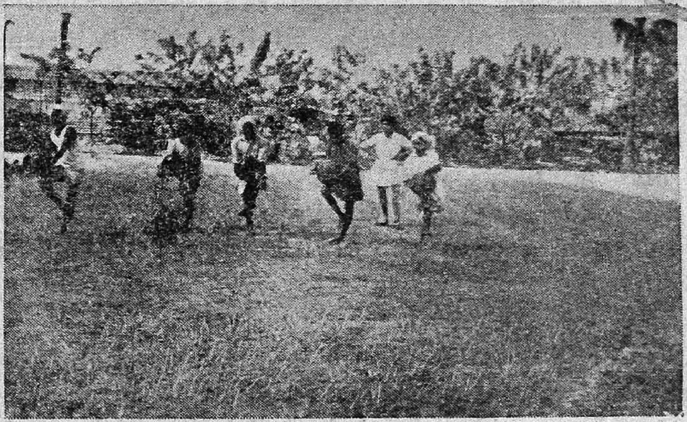

Plate 2

Plate 3

rate is 80 to 100 lb. per acre. One weeding is given in August when the crop is one month old, if necessary. The crop matures in September—October and the yield ranges from 1,000 to 2,000 lb. per acre.

5. **Cowpea** The cultivation is in the main season from June—July, but under favourable conditions it is also grown from October—November. The land is ploughed twice, either lightly manured at five tons cattle manure per acre or not manured at all. Seed is sown at 30 lb. per acre. Main season crops are harvested in November and the late season crops in February. The average yield is 400 to 600 lb. per acre.

6. **Horsegram:** This crop succeeds groundnut, cowpea, tobacco seedbeds, or casuarina, i. e. where there is some fertility to give a successful crop. The sowings take place from October to December. After two ploughings, 30 lb. seed is sown broadcast, covered and levelled. No other operation is done. The crop is harvested from January to March. The yield is 400 to 600 lb. per acre. Lands are leased out for groundnut, cowpea, and horsegram on a half and half share system, the owner supplying the seedmaterial. If manured, it is also done by the owner and in such a case the owner gets two-thirds and the tenant one-third.

7. **Green Chilli:** This is an important crop grown in all small holdings of five to ten cents area under intensive cultivation from January to June. The land is dug twice with spades and well manured with about half a ton of cattle manure per cent, and incorporated by digging. Four to six weeks-old seedlings are planted one foot apart. Splash-watering is given regularly once a day, but in midsummer watering is done twice a day. After planting, sulphate of ammonia is applied every fortnight at one pound per cent. For four days after the top dressing light watering is given twice a day in such a manner that the manure is not leached out into deeper layers but retained in the root zone. Every top-dressing of the fertiliser is followed by light sprinkling of sand taken from the sides of the "doruvus" at about 100 lb. per cent each time. This is another peculiar practice. Where cattle manure is available, powdered manure or powdered groundnut cake are also applied as top-dressings in between the fertiliser doses. A month after planting, pig dung is applied as top dressing at about 50 lb. per

cent, at the base of individual plants. Picking commences one month after planting. Picking green chillies is said to stimulate flowering and fruiting. On an average, three pickings are taken a month. The crop remains for four to five months after planting. From 12 to 15 pickings at an average of one maund per picking, 12 to 15 maunds could be easily expected, fetching at an average price of Rs. 2/- per maund, Rs. 24/- to Rs. 30/- per cent. In summer, there is a regular export of green chillies to the neighbouring places by rail and sometimes the price shoots up to Rs. 4/- to Rs. 5/- a maund.

8. **Brinjal:** The cultivation details are the same as for green chilli in all respects except that a wider spacing of 18″ is given. Picking commences two months after planting and the main pickings are taken for four months from March to June. Normally 12 pickings each of one maund at Rs. 3/- per maund fetch Rs. 36/- a cent. There were instances where one maund was sold at Rs. 8/-.

9. **Jasmine:** It is a common practice in every small holding to set apart about two to five cents for jasmine. The plants are retained in the same plot for about ten years. Layers are taken from old plants. They are planted four feet apart (either way) in August – September, in shallow pits even without any manuring and watered once a day in the absence of rain, till they get established. Thereafter no care is bestowed till next February; when the leaf is stripped off, one basketful (about 50 lb.) of cattle manure is applied in the basins, dug around, and regularly watered. In three weeks the plants begin to flower and picking commences from early March. Watering is continued right through, manuring with one basket of cattle manure per plant once in three to four weeks. Application of sulphate of ammonia is not favoured, though there are instances where it is also applied. It is believed that the application of the fertiliser shortens the life of the plants. During the main picking season of March to June, 12 pickings could be obtained. Each picking gives 4 pounds of flowers per cent, costing Rs. 1/- to 1—8—0, and for the season about Rs. 15/- to 20/- may be got from one cent.

10. **Casuarina:** Casuarina cultivation is taken up on an extensive scale, since one decade and has been paying well, due to remunerative prices. The plantations are largely confined to the lands away from the villages and nearer to the coast. Seed is collected from mature fruits. Nurseries are sown in March-April at

2½ lb. seed rate per cent. The beds are watered once a day. No manure is applied. Seedlings will be ready for planting in July-August, with 1½ feet growth and are sold at Rs. 3/- to Rs. 5/- per 1000. The main planting season is July August. No manuring is adopted. Shallow scoops are made with spade. In the center of the scoop a hole is made with a crow bar and one or two seedlings are planted in each hole and pressed well. Spacing is 4½ feet both ways and 4000 seedlings are required to plant an acre. In the absence of rain, watering is given till they establish themselves. Gaps are periodically filled during the rainy season. The plantation receives watering again for two months in the first summer, thereafter no other care is taken, except engaging a watch collectively, which may come to a rupee per acre per year. The plantations are cut from the 7th to 9th year. About 3000 trees remain per acre, yielding 25 to 40 tons. In recent years, due to high prices, there is a tendency to cut even in 5 to 6 years. In such cases only 15 to 20 tons are obtained. The average price per ton is Rs. 30/- and goes up to even Rs. 60/- during January-February, the tobacco flue-curing season. Usually Rs. 100/- per acre per year is the net return.

11. **Cashewnut**: The cultivation of cashewnut is rather indifferent and confined to lands far away from the villages. In the month of July small pits are made 30 feet apart, and four to six months old seedlings are planted. In the absence of rain the plants are watered till they strike root. The plantations are not usually manured. Sometimes, the seeds are sown in the pits and covered with thorny twigs to protect the germinating nut from bird damage. The plants receive watering again during the first summer. No other operation is given. Watch is engaged during the fruiting season till the garden is sold outright for the usufruct. Fifty plants go to an acre. Inter-cropping with groundnut, cowpea, and horse-gram during the first three to five years is sometimes adopted with advantage. Bearing starts fom the fifth year, but full bearing commences only from the tenth year. During the full bearing stage about 40 lb. of nuts are gathered from a tree costing about four annas a pound. The yield is half of this from the fifth to the tenth year. Cashewnut appears to be remarkably suited to poor sandy soils, and thrives well even under neglected conditions.

12. **Other miscellaneous crops of minor importance**: (1) Amaranthus is grown in small beds throughout the year. (2) "Gogu" is

sown along the borders in rows. The leaf is used as a salad and the plants are finally pulled out for fibre. (3) Cucurbits are raised in both the seasons. In summer, ribbed gourd, bitter gourd, snake gourd, and cucumber are grown.

(4) "Davanam" (*Artemisia vulgaris*): Small nursery beds are sown with seed at one tola per square yard, mulched with straw, and lightly watered with rose can. The mulch is removed after germination and initial growth, after a fortnight. Month-old seedlings with four to five inches growth are planted four inches apart in well prepared and manured beds and watered regularly. Cattle manure is applied as top dressing every fortnight. Sulphate of ammonia is also applied now and then followed by sprinkling of sand and profuse watering. Picking starts a month after planting and continued every ten to fifteen days. The main season is December to May. From 12 pickings of one maund each per cent valued at about Rs. 60/- (at Rs. 5/- a maund) is realised. The price goes up to Rs. 7/- or Rs. 8/- in some years. (5) "Maruvam" (*Origanum marjorana*): The cultivation is identical to that of "davanam"; but no nurseries need be raised as the propagation is by cuttings which are planted six inches apart.

Conclusion: Similar soil and cropping conditions prevail in many places along the entire East Coast bordering the sea. In view of the high water table, the future line of improvement should be directed towards the reduction in the cost of watering by some means or other. Fixing cheap designs of filter points to suit the water table in conjunction with sprinkler irrigation outfit preferably with portable arrangement and worked by a small pumpset or electric motor would answer the need. Even if such units are beyond the means of small ryots, they may prove useful for raising tobacco seed beds. Well-to-do ryots may be able to bring more land under intensive cultivation or lease out lands to tenants with the equipment at enhanced rates.

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A Fruit Rot of Chillies *(Capsicum annuum L.)* caused by *Alternaria solani* (Ell. & Mart) Jones & Grout

by

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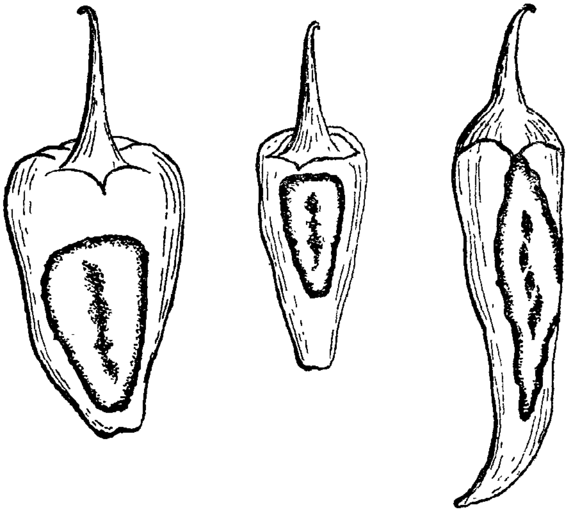
Introduction: Fruit rot of chillies is a disease of economic importance prevalent in many parts of the world. The causal organism differs in different places and more than one fungus has been found to be responsible for this disease. *Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk *(Colletotrichum piperatum* Ell. & Ev.) has been recorded from India (Dastur 1920), America (Halsted 1890) and elsewhere causing anthracnose (fruit rot) of *Capsicum*. *Colletotrichnm capsici* Syd., was first observed in South India, infecting fruits and young twigs of chillies (Mc Rae 1914). Dastur (1921) has described this disease in detail from North India. More than one species of *Alternaria* have been reported to be responsible for the fruit rot of chillies. *A. solani* (Ell. & Mart.) Jones & Grout has been recorded from Georgia by Higgins (1925). Wallace (1929) reported a fruit rot of chillies caused by *A. tenuis* Nees., in Tanganiyka. In Spain, Unamuno (1934) found *A. tenuis f. genuina* Una., to be associated with the rotting of chilli fruits. Bremer (1945(from Turkey stated that *A. longipes* (Ell. & Eve.) Tisd. & Wadk. was the causal agent for the rotting of chilli fruits in that country. *A. capsici-annui* Savul. and Sandu has been known to be responsible for this disease in Rumania (Savulescu & Hulea 1948). Dutt (1938) reported a fruit rot of chillies from Delhi, caused by *Alternaria* but the species was not determined.

In recent years, specimens of chilli fruits affected by *Alternaria* have been collected from Mathurai and Guntur districts. This disease occurred along with the fruit rot caused by *Colletotrichum capsici* Syd., and often passed off for infection by the latter fungus. The present paper is concerned with the isolation of the fungus and study of its pathogenicity, cultural characters and host range.

Material and Methods: The pathogen was brought into culture by the single spore isolation method and its growth on a number of agar media was studied. Inoculation experiments were conducted on fruits kept in moist chambers after surface sterilisation or on those growing on the plants themselves. Leaf and twig inoculations were carried out on young plants grown specially for the purpose. For the study of the rate of growth of the fungus, equal quantities of the inoculum were used and the media were adjusted to the same reaction. The colour nomenclature described in Ridgeway's "Colour Standards" has been adopted for describing the colour of the growths on the various media.

Symptoms of the disease: Fruits which were nearing maturity were ordinarily infected. Brown lesions surrounded by a yellow

halo developed on one side of the fruit. These enlarged and resulted in the formation of irregular sunken patches with a dark brown margin and light grey centre. The latter was overgrown by olive-brown fungal growth. The fruit lost its red colour and usually dropped down. Sometimes the entire fruit was involved in the rot.



Chilli fruits showing the symptoms of the disease

The incidence of fruit rot was very high if the humidity increased or it rained during the maturing stages of the fruits, resulting in a heavy loss of fruits. This disease can be distinguished from the fruit rots caused by *Colletotrichum capsici* Syd. or *Glomerella cingulata* by the absence of the characteristic acervuli on the diseased spots.

The fungus and its cultural characteristics: To start with, the mycelium is internal and after the collapse of the tissues, brown mycelial growths develop on the surface of the lesions. Numerous light brown, septate, unbranched conidiophores are found in clusters of 3 to 6 from the external mycelium, measuring 105 x 4μ (90–144 x 3–6·5). Obclavate, muriform conidia, olive brown in colour are formed, often in chains on the conidiophores and measure 65 x 18μ (49 to 112 x 12 to 25) on the average. The number of cells in the spores varies; 8 to 12 transverse septa and 3 to 6 longitudinal septa are found in each spore. The beak is usually small.

Profuse aerial growth usually develops on agar media. In the initial stages, the hyphae are hyaline forming a whitish aerial mycelium. Later, the growth becomes dark grey and forms an olivaceous black mat on the surface of the agar. The dark

discolouration extends into the medium also. Profuse sporulation was evident on most of the media. The cultural characters of this fungus and the average rate of daily growth on various media adjusted to pH 5·7 are given below:

TABLE I

Cultural characters on various media

Name of medium	Average rate of daily growth in m.m.	Cultural characters after 7 days
1. Oat agar	6·6	Good growth, aerial mycelium dark grey, olivaceous black on agar surface, reverse black, spores plenty in 48 hours.
2. French bean agar	7·5	Fluffy white aerial mycelium, good and uniform growth; the older mycelium tends to be mineral grey, reverse purple black, spores numerous within 48 hours.
3. Maize agar	7·0	Aerial mycelium light mineral grey over a dark dull yellow substratum, reverse sooty black, growth was good and uniform. Spores abundant within 48 hours.
4. Carrot agar	7·0	Loose aerial mycelium, pearl to storm grey, adpressed over a dusky olive-green growth on the surface of the agar medium. Zonations noticed on the reverse; reverse black, spores plenty in 48 hours.
5. Czapek Dox's agar	7·0	Aerial mycelium white to ash-grey in the centre, on olivaceous black background reverse french grey to light violet grey; no spores in 48 hours.

French bean agar appears to be the most satisfactory medium for the growth of this fungus.

Pathogenecity: Repeated inoculations were carried out on surface-sterilised fruits of chillies, brinjal and tomato kept in sterilised moist chambers and those growing on plants. Leaves and twigs of *Capsicum annuum, Solanum melongena, Lycopersicum esculentum, Datura stramonium, Nicotiana tabacum, Gossypium hirsutum* and *Cyamopsis tetragonaloba* were inoculated. The following table shows the results of inoculation.

TABLE II.

Results of Inoculation with the Fungus.

Name of plant	Part inoculated	Method of inoculation	Number inoculated	Number infected
1. *Capsicum annuum*	Leaves and twigs	Wounded	12 plants	Nil
	Leaves and twigs	Unwounded	12 plants	Nil
	Fruits	Wounded	24 fruits	15 fruits rotted within 7 days after inoculation
	Fruits	Unwounded	24 fruits	14 fruits rotted within 7 days after inoculation
2. *Solanum melongena*	Leaves and twigs	Wounded	6 plants	No infection
	Leaves and twigs	Unwounded	6 plants	No infection
	Fruits	Unwounded	12 fruits	10 fruits rotted within 7 days after inoculation
3. *Lycopersicum esculentum*	Leaves and twigs	Wounded	6 plants	No infection
	Leaves and twigs	Unwounded	6 plants	No infection
	Fruits	Wounded	6 fruits	4 fruits rotted within 7 days after inoculation
	Fruits	Unwounded	6 fruits	3 fruits rotted within 7 days after inoculation
4. *Datura stramonium*	Leaves and twigs	Wounded	6 plants	No infection
		Unwounded	6 plants	No infection
5. *Nicotiana tabacum*	Leaves and twigs	Wounded	6 plants	No infection
		Unwounded	6 plants	No infection
6. *Gossypium hirsutum*	Leaves and twigs	Wounded	6 plants	No infection
		Unwounded	6 plants	No infection
7. *Cyamopsis tetragonaloba*	Leaves and twigs	Wounded	6 plants	No infection
		Unwounded	6 plants	No infection

Suitable controls were kept in all cases and they remained healthy throughout the experiment.

The results of inoculation show that the fungus is pathogenic on the fruits of chillies, brinjal and tomato. There was no infection on the leaves of any of the plants tried. The symptoms of infection on the fruits were evident on the fourth day after inoculation. The infected fruits were completely rotten in the course of one week. In all cases the fungus was reisolated from the infected fruits.

Identity of the Fungus: Four species of *Alternaria* have been recorded on *Capsicum*. A comparative statement of the chief distinguishing characters of the different species of *Alternaria* recorded on chillies is given below:

TABLE III

Character of the species of *Alternaria* recorded on Chillies

Name of species	Conidial measurements in μ	Chief distinguishing characters	Authority
1. *A. longipes*	30 — 50 × 10 — 13	Infects only wounded chilli fruits and incapable of infecting tobacco or chilli leaves	Bremer 1945
2. *A. solani*	145 — 370 × 16 — 18	Infects the leaves of almost all solanaceous plants	Higgins 1925
3. *A. tenuis*	30 — 36 × 14 — 15		Wallace 1929
4. *A. tenuis f. genuina*	27·5 — 62·5 × 12 — 17·5	Found on leaves, peduncles floral buds and unripe fruits of chillies	Unamuno 1934
5. *A. capsici-annui*	33 — 82 × 7 — 21	Capable of infecting tobacco and chilli leaves also	Savulescu and Hulea 1948
6. *Alternaria* sp.	14 — 50 × 7 — 19	Capable of infecting all portions of chillie plant	Dutt 1938
7. The present isolate under study	49 — 112 × 12 — 25	Capable of infecting only the fruits of chillies, tomatoes and brinjal	

From the above characters of the various species it can be inferred that the isolate under study does not completely agree with any of the others. But, it exhibits affinities to *A. longipes* in being incapable of infecting tobacco and chilli leaves but infecting the fruits. But the spores are much bigger than those of *A. longipes.* In this character, it comes near *A. solani*, but differs from the latter in its failure to infect the leaves of any of the solanaceous

plants tried. It is considered that it is more likely that the present isolate is a strain of *A. solani* which infects only fruits and not the leaves of chillies, brinjal and tomato.

Control: Diseases caused by *Alternaria* are amenable to control by Bordeaux spray. Since it is customary to spray chillies for the control of fruit rot caused by *Colletotrichum capsici* the same treatment will be useful for the control of the disease caused by this fungus.

Acknowledgements: My thanks are due to Sri T. S. Ramakrishnan, Government Mycologist for affording all facilities in carrying out these studies. This paper was submitted to the First Scientific Workers' Conference held at Coimbatore in 1951 and was discussed in one of the Study Group meetings held at the Agricultural College and Research Institute, Coimbatore. In the course of the discussion, Sri C. Jagannatha Rao asked for information whether the disease was a common one and if so the seriousness and distribution of the same. It was replied that no survey of the disease was made, but that it has been observed in Coimbatore, Mathurai and Guntur districts.

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A Note on the Different Modes of Price Fixation in the Regulated and Unregulated Markets in Madras and other States

by

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In a country like India which is and is bound to remain so predominantly agricultural, the importance of a rational system of marketing cannot be over-emphasised. A mere improvement in production does not very often confer a proportionate benefit on the grower or assist to improve his economic position, because the grower who is ordinarily an indebted man is compelled to sell his produce immediately after the harvest, which usually coincides with a slump in the market. The middleman or the village petty merchant and the wholesale dealer in the assembling centre often get a much bigger share of the price paid by the consumer than the actual producer who labours in the field for a full season. Any plan for improving the lot of the village farmer must therefore, tackle the problem of rural marketing and enable the producer to get as big a share of the price paid by the consumer as possible, eliminating the share of the middle men as much as practicable. This in fact is the aim of all the Regulated Markets controlled by Market Committees set up under the Madras Commercial Crop Markets Act 1933. Though the Regulated Markets seek to assist the grower in many ways, such as bringing the producer into direct contact with the purchaser, elimination of unauthorised deductions and allowances, restricting of brokerage and commission charges to reasonable levels, ensuring cash payment on the spot and the like, the most important service rendered is in the system of fixing the prices for the produce brought into the market. If the price fixation is to be done to the best advantage of the grower the following conditions have to be satisfied.

1. The produce for sale must be kept open for examination and quotation of prices by as many purchasers as possible so that a really competitive price is assured to the seller.

2. The seller must have the final voice in fixing the price i. e. to accept or not the maximum price offered by the purchaser on a particular lot while the buyer shall not have the liberty to go back on the rates once offered by him.

3. All payments must be made on the spot or within such short intervals as may be fixed by the market rules, and the Market Committee must undertake the responsibility for enforcing fulfilment of the contracts entered into between the purchaser and seller at the time of fixing the bargain, without encroaching on the civil rights of either party.

4. All weighments or measurements of produce must be done by those licenced by the Market Committee using only scales and weights or measures bearing the stamp of accuracy affixed by the Market Committee.

5. There must be provision and means of settling disputes arising in the course of transaction expeditiously, by impartial arbitrators.

With a view to achieve these objects the following procedures are adopted in the sales yards of Regulated Markets.

i. Auction by shouting of each lot of the produce and selling to the highest bidder if the rate offered is acceptable to the seller as in Guntur Tobacco Market.

ii. Auction by secret chit tender as practiced in the market yards of the South Arcot Market Committee.

iii. Fixing price by auction for the best quality of the produce and then fixing the rates for individual lots by making allowances for difference in quality from the ideal for which the price is fixed by auction, as in the Adoni Market.

iv. Fixing prices by private negotiation under cover or by open words between the buyer and the seller or his commission agents as described against Tirupur, Amraoti or Dhulia Markets.

The comparative merits of each system are discussed below with reference to the actual details of the systems adopted in some of the important market yards in the country.

(i) **Amraoti Yard**: This is one of the oldest of the Regulated Markets in India and the commodity dealt with is cotton. The market yard opens at 5–00 A. M. when carts with kapas and lint from various villages enter the yard by the main gate and the carts are conducted into the stalls of commission agents of the sellers' choice. At 6–00 A. M. the price ranges and important market quotations including American and Liverpool futures are put up on the notice board of the market yard. The regular trading then starts. The buyer goes to each cart, examines the stuff and quotes his rates for the same under the cover of cloth, the sellers' commission agent acting as the intermediary. When the commission agent thinks that a fair bargain is obtained, he informs the cartman accordingly. It is only when the cartman who has previous instruction from the owner (if the owner is not present on the spot) or the owner himself (if present in person) accepts the rate, the price is openly declared. Immediately an agreement is filled up in duplicate in the prescribed form showing details of the buyer, seller, rate fixed etc., and signed by both commission agent and the purchaser. A fee of one anna per cart is charged by the market committee to the buyer as its fee. Weighment is done by licensed weighmen and the payment is made

on the same day. Thus in effect the transaction is one under private negotiation through brokers or commission agents. Details of bargaining are kept secret. The chief defects are:

i. The illiterate cultivator is entirely in the hands of the commission agent who is often inclined to favour the buyer.

ii. The ancient practice of fixing the price under cover of cloth by secret signs is still in vogue. This keeps the seller in the dark as to trends in the market with reference to the published market data even.

iii. After a few weighments the buyer or his broker frequently finds fault with the quality and asks for a price reduction. The cultivator who usually comes from a long way, bearing all the costs of transport is usually left with no alternative at this stage but to agree to such arbitrary demands. Although market rules provide that prices shall be fixed in the market yard, and that no deduction shall be made except when the quality of cotton is inferior to the sample on the basis of which price is fixed, these rules are only loosely enforced and the general practice is to make deductions in weighments by 1 to 4 Dhadis (7 to 28 lb.) from the actual weight of a cart load. Occassionally carts are also allowed to be taken directly to the ginning factories without entering the yard at all.

(ii) **Dhulia Market**: This is the biggest of the Regulated Markets in Bombay State transacting business of over 50 to 60 thousand bales of lint per year. As at Amraoti the prices are offered under cover after seeing the produce. The ruling prices at Bombay and America are received by telegram and put up every day at the entrance of the yard for the information of buyers and sellers. The practice of settling prices under the cover of cloth is unfortunately in vogue here also. The rest of the procedure is more or less as in Amraoti, but there is better check over the weights and weighment and mal-practices in weighment seem to have been checked. No deductions are allowed in weighments.

(iii) **Adoni Market in Madras State**: The auction sale of cotton and groundnut brought for sale is conducted at 10-00 A. M. on all working days. There are 58 commission agents at this centre and they are divided into six groups, each group being composed of an equitable number of the big and small commission agents and of stocks coming to their shops. If any day happens to be a holiday, the arrivals in shops allotted for that day shall be auctioned next day along with the stocks of the group allotted for that day. Thus each commission agent gets his turn of auctioning the produce of his constituents once a week and in his shops on other days also the sellers so desire.

Prior to the commencement of the auction the buyers go round the shops allotted for that day and examine the stocks put up for sale. In the auction the rate declared is understood to be for the best quality of the season's produce. After the auction declaration, the highest bidder is enjoined to purchase all the produce placed for sale by the Commission Agents in the godowns allotted for the day, at the rate declared in the auction. Produce in the other godowns is allowed to be purchased by the other traders by mutual bargaining and negotiation. For each transaction the rate declared in the auction will be ruling rate for the day. If the produce is found to be of inferior quality reductions in rates will, however, be allowed with the consent of the seller. After the bargain is struck by the buyer, no alteration in the rates will be allowed. In case there are no buyers for the day to purchase the goods in the commission mundies other than those allotted for that day, the highest bidder in whose name the auction has been knocked down is further bound over to purchase the entire produce from other shops as well. This latter provision aims against irresponsible or insidious excitement being promoted in the auction. If there are any disputes in respect of the transactions the committee's decision is final.

The chief defects in the system are that the grower is entirely dependent on the commission agent, and deductions in rates are allowed on the plea of poor quality which might more often than otherwise be used against the interest of the seller, in the absence of any standard and recognised specifications as to quality. The buying commitment in respect of the entire produce in the allotted godowns for the day insisted on might have the effect of limiting the bid to the general average of the quality of the produce in those godowns. This rate is then applied to be the one for the best quality of the season's produce. This kind of bulk auctioning without reference to any specific goods militates against any proper appraisal of quality and against adequate recompense being paid for improvements in quality. Instances are not unknown of prices above the declared rate in auction being offered and accepted. Individual buyers who are inclined to offer better prices in this way are ostracised by the entire body of other traders and in effect a dominating clique among the traders is promoted to the disadvantage of the sellers. The system on the whole is a most undesirable one and it does not encourage individual traders to study the market and operate on it intelligently.

(iv) **Tirupur Yard**: No auction sales are usually held at this yard. The prevailing market rates at Bombay New York and Alexandria are obtained daily and published on the notice board of the Committee. The buyers go round the commission agents' mundies inside the market and offer their rates after examining the stocks available for sale. The price offered by the buyer is noted in a chit and if the rates are acceptable to the commission merchant or to the seller if present, the bargain is struck. In the case of lint, price bargaining take splace outside the market yard and as soon as the transactions are finalised, the buyer and the seller come to the yard and sign the contract form in the presence of the Superintendent of the Committee and leave a sample with the Committee. This practice might be considered to be a weakness in the regulation of the markets as under the existing statutory restrictions no buying and selling can take place outside the market yard within a five mile limit of Tirupur. In case of any dispute in passing the deliveries against such sales, the sample with the Committee is made use of for settling the dispute. In the case of kapas, the merchants report to the Committee at the end of the day in the prescribed form showing details of names of sellers and purchasers, rate and quantities sold. No deductions are allowed for poor quality etc., after the rates are once agreed to.

Here also the growers have to depend on the commission agent, since there is no auction sale in the yard. Though the seller has the option to reject the rates arrived by the Commission agent and the buyer, it is seldom exercised, as in most cases the commission agent acts for the seller. Weights are strictly checked by the committee and no deductions whatever are allowed.

(v) **South Arcot Market**: This is the most important and perhaps the best organised market in South India. More than 90% of the groundnut marketed in the district gets sold through one or other of the eight markets set up by the market committee at important and convenient assembling centres. More than 70% of the quantity thus sold in these markets is brought in by the growers themselves and sold direct without the intervention of an intermediary. Thus the ideal of bringing the producer in direct contact with the purchaser to the exclusion of middlemen as far as possible is achieved in this market to a great extent. Groundnut is brought in the form of kernels in bags and the sale is conducted by secret tender system. Every morning, except on holidays, when the yards commence working, the lots belonging to individuals are given lot

numbers as they arrive. They are then poured out of their bags, shuffled, rebagged and weighed and the weights of each lot is also notified. Slips are then prepared giving lot numbers and these are issued to buyers assembled in the yard between 10-00 A. M. and 11-00 A. M. in two or more rounds of auction fixed at convenient intervals. The buyers go round the lots, examine the quality of each and write in the bid slips against each lot the price they offer for that lot. After quoting prices for all or as many lots as each merchant might be interested in, the slips are deposited in a hundi box kept for the purpose. The box is opened at an appointed hour notified beforehand. After collecting all the slips from the box the Superintendent of the yard reads the prices offered for each lot and the maximum for each lot is announced. If the owner is satisfied, which is usually the case, the sale is confirmed by notifying the price confirmed and the name of the buyer. The weighment chitta made out initially is also completed for each lot with the entry of the name of the buyer and the price determined and one copy each is furnished to the seller and the buyer. In the copy to the seller, the total amount due is also calculated and noted for the benefit of the sellers as a precaution against his being cheated in the calculations. The payment is arranged on the spot by the buyer and he clears the lot. If, however, the rate offered by the highest tenderer is not satisfactory to any seller, he is at liberty to take the produce back or keep it in the Market Committee's godown for reauction on the same day or the next day. Weights and sales in use within the Committee's markets are provided by it and they are tested and kept accurate at frequent intervals. Weighment is also done in the immediate presence of a clerk. This system is perhaps the best and simplest among all the systems followed in the markets of this State. The main difficulty in adopting this system in other yards will be the existence of long-established commission agents functioning between the producer and the purchaser.

(vi) In western countries, open auction by shouting is the method usually followed, as can be seen from the tobacco markets of Kentucky in America.

The sales usually start at 9–00 A. M. and continue throughout the day with a short recess at noon, the buyers moving from warehouse to warehouse. During the height of the season, three sets of buyers operate, in order to keep the tobacco moving and to prevent congestion. At the time set for sale at a particular floor, the various buyers gather round and the auctioneers take their place

near the first basket in the first row. The floor manager of that particular warehouse works one basket ahead of the autioneer and the buying crew, and as the latter come upto the basket he states what he thinks of the minimum value thereof per pound. Starting with this, the auctioneer then calls out the bids and if necessary even goes below the minimum suggested to get the bidding started, and then advances as bids are made in the usual way. The lot is invariably sold to the highest bidder. On the tobacco which is priced $ 6 per cwt, the bid to be raised must be increased by at least 10 cents and for lots priced $ 6·50 to 20, each rise must be by 20 cents and for lots priced from $ 20 to 30 the increase must be only in dollars. These limits are evidently prescribed to facilitate quick sales. The sales are in fact so quick that an average auctioneer disposes of not less than 200 baskets per hour. As each basket is knocked down, the buyers initial the price paid and the commercial grade of the leaf are then entered on the basket as well as in the warehouse office book. The buyers may be representatives of large and small factories, or of foreign Government monopolies, brokers buying for commission or for speculative purposes or mere speculators or 'pin hooks' as they are called by the Trade. The only restriction is that each buyer must be a member of the Lexington Tobacco Board of Trade, for being recognised on the floor. This Board represents tobacco commercial interests and consists of manufacturers or their agents, company buyers, brokers, warehousemen and speculators. The actual farmers are only indirectly represented through their membership in the warehouse companies.

An adaptation of this system of open auction by crying is followed in the market yards of the Guntur Market Committee for the sale of tobacco. Tobacco entered for auction is given an identity card describing the seller, in each lot. Auctioning proceeds bundle by bundle. The bundle is opened for buyers to examine quality and bidding is initiated by an upset price amount fixed by the Committee's auctioneer. The highest bid is marked in the identity card and attested by the auctioneer and the buyer or his representative who also marks the grade as appraised by him. Weighment and settlement at the price declared in the auction follow. The auction in this manner proceeds from 8–00 A. M. to 12–00 noon each day. This system fails to register much advantage to the sellers when there is no buying competition due to lack of sufficient buyers. It also requires the buyer to wait till the

particular lots in which he is interested is brought up for auction. At present only one auctioneer is employed and in days of heavy arrivals he is unable to get through the entire lot within the allotted time of 8–00 A. M. to 12–00 noon.

(vii) Some such system of auction by shouting is followed in some of the unregulated markets in South India also, like the groundnut market attached to the Leigh Bazaar at Salem and the mango market at Vellore. This system has the great advantage of quick and ready disposal, when large numbers of people bring their produce for disposal, side by side with the presence of a good number of buyers. In the other unregulated markets like the tobacco market at Palghat, arecanut markets at Mangalore and the various cattle markets in the State, the system of secret bidding and bargaining under cover of cloth is still in vogue. The parties to these close bids are also usually the buyers and the commission agents acting on behalf of the owners of produce. The system has its own drawbacks from the point of view of the growers' interests, as already explained before.

Considering all aspects, the best system for adoption by the regulated markets in the State seems to be either the open auction by shouting as followed in the West and in Guntur tobacco markets or the secret tender auction followed in the South Arcot Markets. The systems followed in Adoni and Tirupur which promote the dominance of commission agents are not conducive to the interests of the producers.

Summary: The main modes of price fixation followed in the different markets are :—

1. The closed bargain system of fixing the prices under cover of cloth by the sellers' commission agents and the buyers and announcing the rates on obtaining their acceptance by the sellers, followed by regular execution of agreement in the form prescribed by the market committee as is done in Amraoti and Dhulia markets.
2. The system of negotiating the prices by the sellers, commission agents and the buyers and reporting the agreed rates to the market committee for signing the contract as is done at Tirupur.
3. The rather complicated system of auction sale followed in Adoni market of allotting different groups of merchants for taking part in auctions held on each day of the week fixing the price in terms of the best quality of the produce and then allowing deductions in rate for poor quality, and compelling the highest bidder of the day to purchase all stocks put up for sale on that day.
4. The comparatively simple system followed at Cuddalore and other markets in South Arcot of allotting numbers to each lot that is put up for sale and allowing all the buyers to examine each lot and offer their maximum rate for each lot in a slip of paper containing a list of all the lots put up for sale on that day. The maximum rates quoted for different lots are then tabulated by the market superintendent and

announced. If the sellers agree to the highest offers made, the transactions are finalised and the contracts signed in the prescribed form.

5. The open auction by shouting and disposal on the spot as is done in the more advanced markets like the tobacco market at Guntur or the still more advanced tobacco market at Kentucky in U. S. A.

The main disavantage in the first three systems is that the producers are left entirely in the hands of the commission merchants who are often inclined towards the purchasers. In markets like Amraoti and Adoni arbitrary deductions in weight are often made against the alleged poor quality of the produce, even after the transactions are finalised. At Adoni there are other restrictions also operating against the interests of the seller such as restricting of a day's auctions to a particular group of merchants, fixings rates on the basis of an imaginary best quality which invariably results in the bidder claiming deductions against poor quality.

The special advantage of the Cuddalore system is that the producer is brought into direct contact with the purchasers and facilities are allowed for free and open competitive bidding by the buyers. As the bids are made after examination of each lot no deductions are allowed for quality or any other factor after the terms are once finalised. This system as well as the open auction by shouting followed at Guntur are the best among the systems now in vogue in India and they also conform more or less to those in vogue in the more advanced western markets. The main impediment in introducing these systems in all the markets would be the existence of so many commission merchants who act as links between the producers and the purchasers to the disadvantage of the former. It is to be considered how best this difficulty could be got over and a fairly uniform system enforced in all market yards.

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Dormancy and Germination of a few Crop Seeds

by

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Introduction: The importance of "good seed" is well realised in Agriculture. Good seeds are those in which every seed is capable of giving rise to a healthy plant of the kind, when placed under suitable conditions of growth. The quality of good seed is dependent upon a number of factors, such as the maturity of the seeds, purity, the methods of storage adopted, the period of storage after harvest, the age of the seed and the incidence of pests and diseases during storage. For the determination of the quality of the seed and arriving at its real value two important factors namely (i) Purity and (ii) Viability are considered. The data on germination and dormancy both published and unpublished supplied by the various Crop Specialists of the Madras Agricultural Department are summarised in this article.

1. **Paddy**: (a) *(Oryza sativa, L): Dormancy:* Fifty-eight strains of paddy seeds were tested in Paddy Section for germinability commencing from one week after harvest up to several weeks after, until the seeds gave 95 to 100% germination. Short-term paddy strains showed good germination even in the first or second week from harvest, but medium and long duration paddy strains required varying "rest" periods, from three to 13 weeks. Notable exceptions to this general observation were in PTB 7, ADT 6 and ADT 7. PTB 7 is a four-months variety and it failed to give satisfactory germination till after the 9th week, while ADT 6 and ADT 7, the two long duration strains gave good germination even from 6th and 8th weeks after harvest.

(b) *Viability:* This was found to vary with different varieties. GEB 24 maintained a high viability for 13 months, after which there was a steady decline to 30%. Thereafter for another 11 months the same germinating capacity was maintained. CO 1 was good for 15 months, but dropped to 49% in 24 months. CO 2 and CO 3 showed a little more variation and after 12 months dropped to 20% in 24 months (Paddy Specialist, Station Report. 1926-27).

(c) *Storage and Germination:* Drying paddy seed material soon after threshing and then storing is very important in maintaining the viability of seeds. In non-dried lots the germination is spread out and as the seeds become older, they lose their viability very badly. Trials at Maruteru have shown that the seeds stored even in four-fold gunnies lose their viability badly during the monsoon season; but occasional dryings improved the viability in such seeds. It was also found that a high percentage of viability could be maintained by storing the seed in double gunnies, with two or three dryings in the interval.

The effect on paddy germination of napthalene used during storage to prevent insect attack, was investigated at the Agricultural Research Station, Aduthurai and the following observations have been recorded; (i) Varying quantities of naphthalene did not affect germinating capacity of the dry seeds of ADT 2, 3 and 4 for one year, after which indications of deterioration were visible, while in the case of *Jeeraga sanna bhatta* (AOB 178) a scented variety, the fall in viability was much earlier, in about six months by naphthalene treatment. (ii) Paddy varieties stored in gunny bags along with naphthalene are not affected for a period of seven months, after which the germination becomes slow. (iii) Naphthalene left with seeds soaked in water before sowing did not injure the growing embryos but if the seeds, are subjected to the influence of naphthalene vapour after germination had started, the tender radicle and plumule were injured. (iv) The combined action of naphthalene vapour and a saturated moist atmosphere seriously affect the viability of paddy seeds within a much shorter period than by humid atmosphere alone.

In the storage of paddy seed in Malabar and South-Kanara, especially with reference to strain CO 3, it is found to deteriorate during the monsoon season, when stored in gunney bags or *murra* (straw twists). Investigations with different varieties of rice have shown that there is a close correlation between such deterioration and the capacity of the grains to germinate immediately after harvest. A simple method to overcome such deterioration was evolved at the Agricultural Research Station, Pattambi. The seeds were soaked in water for about 5—10 minutes and air dried, taking care to see that they did not dry to excess. The treated and stored seeds gave 80 to 100% germination while the control gave only 12 to 30%. The treatment does not affect the yield of either the grain or straw of the resultant crop.

Paddy seed kept in cold storage at 0–4°C at Coimbatore, maintained their viability even after 15 years of storage.

2. **Millets:** (a) No work appears to have been done so far, on the dormancy of millet seeds.

(b) *Viability:* Well-dried seeds of millets kept in tin screw-top bottles have maintained about 70% germination for a period ranging from two to three years. With the preservation of large quantities of seeds for seed purposes germination tests were carried out in 4 strains of cholam (CO 4, CO 7, CO 8, CO 9) and one strain of cumbu CO 1, after storage in metal containers with frequent dryings. In cholam the initial germinations were ranging from 91 to 96% in the four strains and after 23 months of storage the germination ranged from 69 to 78%. In cumbu the germination at the start was 96·5% and this was maintained for 23 months. In Poona, Sonavne (1928) found that in cumbu germination fell from 94·5% in the first year to 61·2% in the fifth year, and in cholam the same author found the initial germination to be 89·7% and after five years to be only 79·1%.

(c) *Storage and germination:* An experiment for determining the loss in germination and deterioration in storage, was conducted in the Millets Section with *Cholam*, *Cumbu*, *Ragi*, *Tenai*, *Panivaragu* and *Samai*. Forty pounds of seeds in each were packed in (i) single gunny and (ii) double gunny and subjected to (a) sun drying once a month and (b) no sun drying under each of the two packing treatments.

(i) **Cholam:** *Periodical drying vs. no drying;* The sun-dried seeds show a definitely better germination, than seeds which are not periodically sun-dried. At the end of one year, the sun-dried seeds showed a germination ranging from 61 to 70%, as against 33 to 58% in seeds that were not dried.

Storage in single gunny vs. double gunny: Storing in double gunny did not show any decided advantage over storage in single gunny at the end of one year. After this period, there was a rapid fall in the germination of grains in all the methods of storage, due to heavy infestation by storage pests.

(ii) **Cumbu:** The grains of cumbu keep better in storage than cholam grains. There was no appreciable difference in germination between the different treatments under storage.

(iii) **Ragi, Tenai, Panivaragu** and **Samai:** These grains keep very well in storage and the initial germination percentages were maintained even after 22 months of storage. They do not also seem to need much attention, as they are less liable to insect attack than either cholam or cumbu. There was no difference between double and single gunny packings.

3. **Pulses:** Studies on the dormancy and viability of pulse crops have not so far been undertaken in this State. However, the little information on dormancy available from other States shows that green gram *(Phaseolus radiatus)* and black gram *(P. mungo)* gave low germination when tested immediately after harvest but improved later, with storage (Sonavne 1928). Patwardhan (1927) found that hard seeds which were more in number in the initial stages decreased with storage, thereby showing that the hard seeds both in green gram and black gram lose their hardness within a year of harvesting and storage.

Longevity: Sonavne (1928 & 1934) reports that longevity of pulse seeds range from seven to more than 12 years. The seeds gave germination over 70% even after seven years of storage, after which period there was a deterioration in germination. However, a certain proportion of the seeds continued to be alive even after 12 years, in three species (1 to 3) while the rest lost much of their viability by 10 to 12 years.

Species	Year by which 70% of germination was recorded.
1. Phaseolus radiatus	11 Years.
2. P. mungo	9 ,,
3. P. aconitifolius	11 ,,
4. Cajanus cajan	7 ,,
5. Cicer arietinum (Deshi gram)	9 ,,
6. Cicer arietinum (Kabuli gram)	7 ,,
7. Dolichos biflorus	7 ,,

4. **Groundnut:** (a) *Dormancy:* Extensive studies have been made on the dormancy of groundnut seeds (John C. M. et al 1948). The seeds of the spreading variety are dormant and need about 2 to 2½ months from harvest to give good germination. Seeds of the bunch variety have no such dormancy period.

(b) *Viability:* Groundnut kernels and pods keep their viability upto four years when stored in air-tight containers but deteriorate after 12 months when stored in ordinary gunny bags, or tins. Sonavne (1928) reports 92·6, 74.5, 60·2, 28·5 and 23·8 percentages of germinations in five successive years during storage in glass bottles, with a naphthalene ball inside.

(c) *Storage and germination:* Groundnut kernels from the summer crop (February to July), undergo deterioration in storage more rapidly than the kernels from the winter crop. (July to December). Kernels having more than 5% moisture at the time of storage deteriorate to a more marked extent than kernels having less of moisture. Kernels with a high percentage of splits and broken bits

deteriorate rapidly. Storing of groundnuts in the form of pods reduces deterioration considerably, as compared to storing them as kernels.

5. **Gingelly**: *(Sesamum orientale) (S. indicum)—Dormancy:* There is no period of dormancy for the seeds of gingelly. *Viability:* From preliminary experiments conducted in the Oil-seeds section it has been found that gingelly seeds stored in air-tight containers remained viable upto three years. In Poona (Sonavne—l. c.) the seeds kept in bottles continued to give 80·5% germination in the fifth year, while the initial germination in the first year was 85·6%.

6. **Castor**: *(Ricinus communis):* The seeds are non-dormant in castor and they keep their viability for about three years.

7. **Coconut**: *(Cocos nucifera):* No experiments appear to have been carried out on the dormancy and viability of coconut seed. The coconut seed is harvested from the parent trees when it is over 12 months old, when the husk is turning brown and drying up. The seed requires a resting period till the husk gets completely dried up.

As regards the viability of the seed it is dependent on the milk inside the seed nut. Seed nuts which do not have milk inside, very rarely germinate. Viability tests for long periods are not of practical importance in coconuts as the seed nuts will usually be planted within six months after harvest. The method of storing nuts to retain the water inside, for about six months is, therefore, important and experiments have been conducted to find out the most efficient method. Seed nuts when kept exposed in storage soon lose both the water and viability. They can however be stored for about nine months in sand without much loss in viability. Nuts harvested in march could be stored in sand for a period of even nine months, with a germination of 76%. For periods of six months and less the germination is normal, going upto 95% when the seed is preserved in sand.

8. **Cotton**: *Gossypium,* spp.: (a) *Dormancy:* Information on the dormancy of cotton seeds is not available.

Viability: Cotton seeds can remain viable even upto 19 months from the date of harvest. In cotton, the seeds required for sowing need not ordinarily be preserved for a period exceeding five months from the date of harvest, although seed stocks left over in Government Seed Farms after the season's sowings, present a serious problem. The experiments conducted by the Cotton Specialist,

Coimbatore, indicate that seeds harvested in one season, retain their viability for two successive seasons. If the germination capacity of the surplus stock at the end of the first sowing season is satisfactory, say upto 70%, periodical drying will help to maintain the seeds in a satisfactory condition for sowing in the next season. Sonavne (1928) reports only 58·6% of germination in cotton in the first year which rose to 67·3% in the second year and thereafter fell to 58·0, 55·8 and 53 3 percentage, in the third, fourth and fifth years respectively.

(c) *Storage and germination:* Experiments to ascertain the germination of cotton seeds in the lower bags when arranged in tiers indicated that the top layers recorded significantly better values in both total percentage and rate of germination. It is desirable to recommend storage of cotton seed in depots in tiers of not more than six bags.

10. **Green Manure Crops:** A few green-manure crops gave the following data in the initial germination tests and after 45 months of storage in the Botany Section, Coimbatore.

Green manure crop	Initial germination	After 45 months of storage
Sunhemp	63—77·5%	53—59%
Pillipesera	71—83%	41—47%
Daincha	82—88 5%	43·5—51·6%
Kolinji	46—52%	43—55%
Indigo	36—45%	30—42%

In Kolinji the germination increased after a few months of storage and high germinations of 71 to 82% were obtained between the 15th to 18th months of storing.

Indigo showed poor germination from the beginning. Under storage treatments of sundrying it was found that there was a decrease in germination percentage with sun-drying, while under non-sundrying the germination percentages were maintained without deterioration even after two years of storage.

11. **Fodder and Pasture Grasses:** (a) *Dormancy:* No information is available on the dormancy of grass seeds, and trials have just been initiated in the Botany section.

(b) *Viability:* The seeds of a few South Indian fodder grasses were tested for their viability (Chandrasekharan et al 1950), the seeds being stored in thick brown paper bags and tested in germination trays in the laboratory.

Only a few grasses like *Panicum antidotale* and *Enteropogon monostachyos* gave good germination, reaching 80%. The popular *Cenchrus ciliaris* and *Iseilema laxum* have only 35 to 48% germination capacity and the other grasses are even less, giving only 25% germination.

(c) *Storage and Germination:* Generally with storage, there is decrease in germination capacity every year. Many of the grasses retain their viability in the second year of storage but deterioration is evident from the third year. Except in a few, many of the grasses have lost their viability in the fourth year of storage completely. But in temperate regions pasture grass seeds retain their viability upto light or even 13 years. (Carruthers. 1911). Only in *Panicum antidotale* (Australian drought-resistant grass) the germination percentage continued to be high (65 to 87%) upto six years in storage at Coimbatore.

Discussion: It is believed that crop seeds do not germinate well when kept for more than one year after harvest. The data available on some South Indian crops presented above, show that in most cases the seeds remain viable for over two years when tested under laboratory conditions. More information remains to be gathered regarding the germination of crop seeds when stored under ryots conditions.

It is also generally believed that in humid climates, crop seeds lose their viability within a year (Robertson & Lute 1933). The viability of seeds under arid conditions have to be studied in more detail before any conclusion can be drawn. Percival (1935) recommends two years as the time within which it is advisable to sow wheat and maize seeds in temperate regions. Observations on these two crops by Sonavne (1928) in tropical conditions at Poona show that viability remained good for about five years. It is therefore, necessary to work out the viability of the crop seeds in detail for tropical conditions, to determine the time upto which they can be stored, for sowing purposes.

The percentage of germination which should be considered as good, fair and poor for each crop seed is another point which needs definition. From the data available so far the following is considered as a tentative definition of germination percentages.

Crops	Percentages of germination, on which it is considered to be		
	Good	Fair	Poor
	Above	Between	Below
Paddy	95	90—95	90
Cholam	90	80—90	80
Cumbu, Ragi, Tenai, Samai, Panivaragu, Kudiraivali	90	80—90	80
Varagu	85	70—85	70
Pulses	90	80—90	80
Groundnut	90	80—90	80
Gingelly	85	70—85	70
Cotton	80	80—80	60
Sunhemp, Pillipesara	90	80—90	80
Daincha	80	70—80	70
Kolinji	80	60—80	60
Indigo	65	55—65	85

In most of the crop seeds in the tropics, dormancy has not been studied in detail. Harrington (1916) found that dormancy exists among many species of cultivated plants. Spaeth (1934) states that "the seeds of cultivated plants have been found to be less dormant than those of the wild species from which they have been derived. Most of the causes of dormancy are hereditary; however, such characters as the impermeability of seed coat as one of the causes for dormancy, may be modified by the climate in which the seed is produced." Seeds having dormancy do not germinate before their dormancy period is over. The methods by which germination can be hastened in dormant seeds also require investigation.

Acknowledgments: The authors are thankful to the various Crop Specialists for the information furnished by them, which has been freely used in this paper.

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REVIEWS

Flore du Congo Belge et du Ruanda-Urundi — Spermatophytes. Vol. IV. *Publications of the Institute National L'Etude Agronomique du Congo Belge. Brussels 1953. p.p. 1-314 (with a map and illustrations in the text):* This part deals entirely with the *Papilionaceae* (part 1) (1. *Sophoreae* by L. Toussaint ; 2. *Genisteae* by R. Wilczek ; 3. *Trifolieae* by J. B. Gillet and 4. *Loteae* by R. Boutique). The tribes have been divided according to the nature of the stamens viz., I. A. free or adnate at base ; B. Variously united. II. Stamens diadelphous (9) + (1) or (5) + (5). Further classification is on the petals and then the pods, dehiscent or indehiscent. *Sophoreae* has been divided firstly on the leaf character – A: unifoliate and B: plurifoliate. Next are taken into consideration the clayx campanulate or non-campanulate nature of inflorescence, presence or absence of bracteoles. Eight genera are dealt with. In the tribe *Genisteae* five genera have been described. Of these the largest number of species are in *Crotalaria* (189 species). In *Trifolium* the classification is done primarily on the stipule character and secondarily on the inflorescence. Only two genera are dealt with. In *Loteae* only the genus *Lotus* is described. Belgian Congo is said to have about 80 genera and 800 species. The distribution of these genera and species is of great interest to India in that similar genera occur here also and therefore there is great scope for introduction of the species especially of economic tribes like *Genisteae (Crotalaria), Phaseoleae, Vicieae* etc. (N. K. S.)

Journal of the Annamalai University. Vol. XVIII; 1953. (Published by the Annamalai University, Annamalainagar: Pp. 228.) This volume has many interesting topics from philosophy to science and literature written by eminent workers in the field.

Studies on the mercuration of aromatic compounds by V. Thiruvenkatachari:— This is a part of the thesis submitted by the author for his M. Sc. degree, and deals with the various reactions like halogenation, nitration, bromination and mercuration and the author has in particular tried to fit in his observations in mercuration to prior references of work.

Suryanarayana, C. V. An alternative to Bancroft's over-voltage theory in the interaction of metals with nitric acid:— The reaction between the metal and nitric acid is discussed by the author in terms of the Bancroft's theory which is based on the older view of Armstrong and Acworth, according to which the reaction was visualised as an electrolytic action occurring in two phases, at the cathode and at the anode and that when the distance between the electrodes vanishes a chemical reaction occurs. This theory is criticised by the author based on Dhar's criticism of the same and presents a new conception of the reaction as crystal energy of a metal as also of all the inorganic and organic reducing agents in their interaction with HNO_3. (A. M. K.)

Dr. S. Krishnamurthy has given a handy tabular statement of the chief distingushing characteristics of the species of *Citrus* based primarily on Swingle's classification. As the author has put it, no final word as yet has been said about *Citrus* taxonomy. He has also explained in what way his classification differs from that of Swingle and has added a list of correlations. This will be very useful for all students of *Citrus*. The Agricultural Department of the University though young has recorded some of its work in the trial and propaganda for the improved strains of paddy. As a seed-farm it has been able to give the Department of Agriculture, Madras with pure seed enough for two thousand acres. Both short and long duration strains are being tried. A short note also appears regarding the use of zinc phosphide as a rat poison and the results obtained in its trial at the University-Extension Farm. (N. K. S.)

Perhaps the most interesting article in this number is the one by Sri C. R. Myleru on "Some Dravidian loan-words in English". The writer traces the derivation of a number of Dravidian words that have passed into current English usage, such as curry, peon, paddy, betel, mango, cash, cooly, coir, etc. Although some of these derivations might not be accepted by all, as also the claim that they are all from Tamil, they are more lor less highly suggestive and should serve to stimulate a deeper study of this question. Another very pertinent observation is on the British knack of absorbing into the English language expressive terms and words from a number of foreign tongues. As the writer points out, this shows a very progressive outlook and an abundant vitality and adaptability and is one of the main factors in English being practically a world language at present. This knack of taking in new words from other languages and making them their own is far better than wasting time and effort in translating them into indifferent and unintelligible 'synonyms' as some of our Indian languges are doing now, in the case of foreign words. (T. R. N.)

Other absorbing articles like Ramanuja, a Panentheist, by John C. Plott, Recent Trends in Federal finance by R. N. Podwal etc., also occur.

EXTRACTS AND GLEANINGS

Chemical Destruction of Potato Tops: The destruction of potato tops is frequently desirable, either to prevent the spread of diseases such as Irish blight from infected haulms to maturing tubers, or to hasten the maturing of a potato crop. Sulphuric acid in 15 percent solution, and dinitro herbicides are commonly used for this purpose in the United Kingdom and in parts of North America where blight attacks are prevalent, while mechanical methods of killing the above-ground part of the patato plant are also used overseas. In Australia these practices have been used but little commercially.

Sulphuric acid gives a very satisfactory kill of potato tops under a range of conditions but the high price of this chemical and the difficulties and danger associated with its very corrosive character make its use in Australia undesirable. Sprays of sodium dinitro–ortho–cresylate (sodium DNOC) alone and mixed with diesel oil or sulphate of ammonia, gives a reasonably good kill of potato tops in some instances. In view of this uncertainty and the fact that on at least one occasion the tubers from plants killed with this chemical showed internal discolouration, blistering of the skin, and a taint resembling the smell of carbolic acid-type disinfectants, its use as a herbicide for potatoes cannot be recommended. Other chemical herbicides which were used with indifferent success are sodium arsenite and sodium chlorate and sodium ethyl xanthate.

One chomical proved outstanding in trials over the past three years at Hawkesbury. Pentachlorphenol, commonly used as a wood preservative. dissolved in creosote as a 5 percent emulsifiable concentrate, was used at rates of 2 lb. to 4 lb. per acre, emulsified in 80 gallons of water with 0·1 percent wetting agent and sprayed on the potato tops up to three weeks before the tubers would normally be sufficiently mature to dig as new grade. The 2 lb. rate gave a "good to fair" kill, while rates of 3 lb. and 4 lb. per acre gave a fair kill in three days and an almost complete kill in seven days. With the two higher rates of application maturity was hastened by from ten to fourteen days and tubers were neither discoloured nor tainted. Pentachlorphenol is also toxic to the usual weeds found in potato crops, but to secure a complete kill of such weeds the gallonage of spray should be increased and spray coverage extended to cover both weeds and crop rows.

Hastening Maturity: There are two drawbacks associated with the use of chemical herbicides to hasten the maturity of potatoes. In trials at the Hawkesbury Agricultural College yields have been decreased by as much as 30 percent by killing the tops three weeks before the normal harvest time for new potatoes; there is also a danger of internal discolouration of the potato tubers. Under dry weather conditions, where a slow kill is desirable, the soil surface should be firm enough to allow the passage of mechinery and machanical methods of potato top destruction would be practicable. A machine known as a rotobeater, resembling a rotary hoe, has been used overseas for this purpose, but trials at Hawkesbury were restricted to scything off the top of the plants. On Saranac potatoes under summer conditicns in January last, this practice proved as successful as the best spray treatments in hastening maturity.

Conclusions: It may be concluded that pentachlorphenol in 5 percent solution in creosote, applied as a low or high volume spray, at rates of 2 lb. to 4 lb. per acre (active ingredient), alone are emulsified in water, has been proved a satisfactory herbicide for potatoes grown under other than very dry conditions, and that scything of potato tops under reasonably dry conditions will hasten tuber maturity. Also, when potato tops are killed before the skins are sufficiently firm for digging as new grade, yields will be reduced. (Agricultural Newsletter, Australia No. ACN/440).

All About the Earth: 1. *Earth's Age is 4·6 billion years* is the conclusion of C. C. Patterson of Cal. Tech. from the analysis of lead isotopes in meteors and Oceanic minerals. (Chem and Eng. News Nov. 1953.)

2. *Earth was never molten.* According to Harold C. Urey of the Institute of Nuclear studies of the Chicago University. His theory is that the earth did not pass through initial Molten phase but was formed through cementing of practicles of dust present in the clouds of hydrogen and helium swirling about the sun with water, ammonia and hydrocarbon at low temperatures. These formed much like meteorites and asteroids. Large objects thus cemented together then accumulated to form the earth. (Chem and Eng. News Dec. 1953.) A. M. K.

Control of weeds: (i) *Cyperus rotundus:* Deep ploughing (av. depth 13-14") showed diminution in the weeds next season sown with cotton.

(ii) *Water weeds: Najas pectinata, Potamogeton nodosus, P. crispus, P. perfoliatus, P. pectinatus, Ottelia alismoides, Vallisneria aethiopica, Chara globularis* found growing in canals major, minor and smaller distributory ones. Fernoxone mixed with river silt was tried. This should not be applied if any cotton crop is on the field. In a few cases a mixture of the above with 10% slaked lime was also used. When irrigations were stopped and water level in the canal became stable applications of the mixture was done by hand by a team of four labourers and one supervisor, the labourer wading in the water, each with an empty petrol tin filled with the mixture. The tin floats in the water and moves along with the worker. A uniform distribution was thus obtained. The weed began to wilt with in a week of application and progressively increased with time but it was found that the rhizomes and seeds were in no way affected. No difference was observed between limed and unlimed treatments, A number of points were noted. Fernoxone, though non-poisonous to animal life, in higher doses imparts a phenolic flavour to the water making it unpalatable. So an alternative source of drinking water has to be found for villages which depend on canal water. This appears to be selectively absorbed by fish which develop an unpleasent flavour.

Treatment of seed with fertilizer solutions: Fifty grams of seed were wetted with water and immediately dried on a cloth. After weighing to estimate adherent moisture the lot of seed was placed in appropriate solution for one hour. At the end of this time the seed was removed, dried on a cloth and reweighed. Soaking was then resumed for another hour and seeds again weighed. This process was repeated upto five hours in water and various solutions. Solutions used were K_2HPO_4 and KH_2PO_4; strength 0·5, 1·0, 2·0 and 4·0 M. (The uptake of water as determinedd by weight of soaked seed was found to decrease with increase in concentration e. g. after 5 hr. in K_2HPO_4 0·5 M—68·3; 4·0 M—11·3; KH_2PO_4 0·5 M—62·0; 2·0 M—35·0; water 70). Too long soaking impairs germinability also.

Thirty-days old seedlings from pot experiments showed no significant increase in weight in cotton but sorghum showed some difference especially in Soln. A....1 M. KH_2PO_4 and 1 M. KNO_3; Soln. B....1 M. KH_2PO_4 and 0·5 M. KNO_3. It was noticed that the total plant weight was below 5% level of significance but when portions below ground alone were considered the significance was above 5% level. It is felt that this effect may be better utilized in rainfed sorghum sowings (Ann. Rept. Res. Division. Ministry of Agric. Sudan. Govt. 1950-51; Sec. A Economic Botany. M. Corquodale & Co., Ltd. (Sudan) 1953). (N. K. S.)

Weather Review — For the month of March, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total for the month	Departure from normal	Total since 1st January	Division	Station	Total for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	0·1	— 0 2	2·8	South	Madurai	1·3	+ 0·6	4·8
	Tirurkuppam*	0·0	— 1·0	3·1		Pamban	0·7	— Tr	3·4
	Vellore	0·2	— 0·1	2·5		Koilpatti*	3·3	+ 2·0	7·7
	Gudiyatham*	1·3	+ 1·0	3 4		Palayamcottai	4·9	+ 3·9	8·2
						Ambasamudram*	8 4	+ 6·0	17·2
East Coast	Palur*	3·5	+ 2·5	6·8	West Coast	Trivandrum	5·6	+ 4·1	9·3
	Tindivanam*	4·6	+ 3·9	7·5		Fort Cochin	3·6	+ 1·6	5·1
	Cuddalore	7·0	+ 6·3	13·1		Kozhikode	1·0	+ 0·6	1·2
	Nagapattinam	0·9	+ 0·1	4·9		Pattambi*	2·6	+ 2·2	2·6
	Aduturai*	2 6	+ 2·1	5·3		Taliparamba*	1·0	..	1·5
	Pattukottai*	1·9	— Tr	6·2		Wynaad*	1·1	— 0.2	1·2
						Nileshwar*	1·2	+ 0·9	1·5
						Pilicode*	1·4	+ 1·0	1·6
Central	Salem	0·3	— 0·2	1·3		Mangalore	0 2	— 0·3	0 5
	Coimbatore (A. M. O.)*	0·9	+ 0·6	4·3		Kankanady*	0·6	+ Tr	1·1
	Coimbatore	3·4	+ 2·9	6 9	Hills	Kodaikanal	5·1	+ 3·3	11·9
	Tiruchirappalli	1·1	+ 0·7	2·9		Coonoor*	9 6	+ 6·5	19·7
						Ootacamund*	1·8	+ 0 8	4·2
						Nanjanad*	1·7	+ 0 8	3·8

Note:—1. * Meteorological Stations of the Madras Agric. Dept. 2. Tr 1 to 4 cents.

A low pressure wave moved westwards across the Comorin—Maldives area on 1-3-1954. Another low pressure wave traversed the same path on the 4th and 5th March 1954. On 7-3-1954 a low pressure wave was moving westwards across the extreme South-east Bay of Bengal. This slowly moved towards west and developed into a shallow 'low' over the extreme South-west Bay of Bengal on 11-3-1954. This intensified further and lay 150 miles South-east of Nagapattinam on 12-3-1954. On the next day it weakened while crossing the Palk Strait and lay as a trough of low pressure off Malabar—Kanara Coast on 14-3-1954, but became less marked on the following day. Under its influence fairly widespread rains occurred in the Madras State from the 12th to 15th of March.

A low pressure wave again moved westwards across Ceylon—Comorin area on 17-3-1954. On 19-3-1954 a feeble trough was forming in the east Arabian Sea of the Konkan Coast. This persisted for three days and became less marked. In the meanwhile a low pressure wave moved westwards across the Southern Bay of Bengal and persisted over Ceylon—Comorin area for three days from 22-3-1954 and passed away westwards. A series of six Western disturbances passed over North-west and North India during this month. Day temperatures were below normal in Tamilnad especially after 12-3-1954. The noteworthy rainfalls and the Zonal rainfall for the month are furnished below:

Date	Name of Place	Rainfall	Name of Zone	Av. rainfall for March	Dep. from normal	Remarks
13/3/54	Cuddalore	4·4″	North	0·40	— 0·08	Just below normal
14/3/54	Palayamkottai	3·3″	East Coast	3·42	+ 2·49	Far above normal
,,	Ambasamudram	2·18″	Central	1·43	+ 1·00	Above normal
17/3/54	Coonoor	4·85″	South	3 72	+ 2·50	Far above normal
24/3/54	Trivandrum	3 1″	West Coast	1·83	+ 0·99	Above normal
25/3/54	Coimbatore	3·0″	Hills	4·55	+ 2·85	Far above normal

Agricultural Meteorology Section
Lawley Road P. O.,
Coimbatore, 12—4—1954

C. B. M. & M. V. J.

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Editorial

In the past spices played an important role in the history of mankind leading to the discovery of new lands, new sea routes and colonisation by the European nations. They have again attained an international importance today as a result of the last global war. India finds itself in an enviable position as the sole supplier of many of these spices. It is but natural that she should strive to evolve means and methods to maintain her dominant position regarding these commodities. Her serious rivals are the Indonesian and Malayan countries and possibly tropical Africa and tropical S. America. The Spices Enquiry Committee appointed by the I. C. A. R. to go into the several problems of the improvement and expansion of these dollar-earning crops and also of cashewnut have recommended the creation of the separate fund of 1·25 crores to be expended on the six important spices and cashewnut. The Committee after an extensive enquiry tour and first hand study has submitted a comprehensive report. Three regional advisory committees are recommended to be located at (1) Travancore-Cochin, (2) Malabar and South Kanara and (3) Mysore including Coorg and North Kanara. With regard to pepper the Committee has rightly warned the growers and traders that unless rapid improvement such as replacement of unproductive vines with more profitable ones, adoption of intensive cultivation methods and lowering the cost of production, the leading position of this country may be lost. To help promote this end the Committee has recommended the raising of a fund of one crore of rupees from the export duty levied on this spice. Cardamom on the other hand has not the possibility of further expansion of export trade. India is the main supplier and the produce exceeds the requirement. Hence the Committee recommends investigation into possibilities of utilising the crop here itself and particularly improvement of market intelligence in this crop. Ginger though produced in large quantities suffers from competition from Trinidad etc., and has to be improved

Contributions of the Mechanical Fractions of the Soil and its Organic Matter towards Potash fixation*

by

A. N. PATHAK,
(Soil Microbiologist, Sabour, Bihar)

Introduction: Perhaps the first use of the world "fixation" was in reference to nitrogen, following the famous discovery of Hellriegel and Willfarth. Fixation was later on applied to immobilization of phosphorus by soil. Now the importance of potash-fixation on the lines of nitrogen and phosphate-fixation has been fully appreciated and investigated. Accordingly the phenomenon of potash-fixation was studied on our soils.

Historical: Studies relating to potash-fixation by soils have been made by Raney and Hoover (1947), Walsh and Cullinan (1945), Attoe (1947), Ayres (1941) Hauser (1941), Martin (1946), Volk (1938), Jacob (1940), Page (1944), and Joffe and Levine (1947). But little work has been done to determine those fractions of the soil that are more active in potash-fixation.

Pathak, Shrikhande and Mukerji (1950) studied the potash-fixing capacity of the different mechanical fractions of the soil and its organic matter. They observed that potash-fixation was exhibited by all the three mechanical fractions of the soil and also that organic matter depressed potash-fixation. Gourley and Wander (1919), Sturgis and Moore (1939), Walker and Sturgis (1940) and Worsham and Sturgis (1942) have also pointed out from field experiments that organic matter exerts a depressive effect on potash-fixation. Worsham and Sturgis (1942) observed that potash-fixation in soil varied from 0·0 to 209 ppm. in Portland silt loam and Sharkey clay loam. Comparison of potash fixed in A and B horizons of all the soils showed an increase of fixation in the B horizon. The addition of organic matter decreased the fixation of potash by 6 to 41 ppm. Jaffe and Kolodny (1937) have recorded that the quantity of potash fixed varied from 0·31 to 2·4 mg. and that organic matter is not capable of fixing potash. Martin (1946), working with arid soils, could not attribute fixation to the presence of organic matter and Joffe and Levine (1947) also found that the addition of organic

* A part of thesis for the degree of Doctor of Philosophy in the University of Agra, U. P.

matter depressed fixation. They also observed that when potassium acetate was added 17·7 mg. potash was fixed as compared to 13·7 mg. with potassium chloride. Similar differences in the amount of potash fixed with different potash-salts have been recorded by DeTurk, Wood and Bray (1943). They studied potash fixation in corn belt soils and observed that the addition of potash as phosphate resulted in greater fixation than addition of equivalent amounts as chloride. The amount of potash fixed as phosphate was 1½ to 2 times greater than the amount of potash fixed as chloride. Sturgis and Moore (1939) studied potash-fixation in Louisiana soils and reported little fixation of potash when applied as potassium chloride. Raney and Hoover's (1947) results on potash-fixation with potassium chloride and dipotassium phosphate also indicate differences in potash-fixation with different potash salts.

Some of the above observations, particularly the effect of organic matter on the potash fixing capacity of the different mechanical fractions of the soil were investigated here with potassium chloride and dipotassium phosphate.

Plan of Investigations: Composite samples of soil were taken from different locations in an acre of the manured and unmanured plots from the Kanpur Agricultural College Students' Farm. Six randomised places were located for profile digging. Samples were collected separately from the manured and unmanured plots from 0–6″, 6″–1′ and 1′–2′ from each of the six profiles. After thorough mixing the various mechanical fractions of the soils were isolated and kept for analysis.

The soils and their mechanical fractions were shaken for 6 hours in an end-on shaker with potash-solution containing 5·0 mg. K_2O per ml. of solution. Ratio of soil to solution was adjusted to 1 : 10. After shaking they were filtered and 5 ml. of the clear filtrates were then used for the estimation of potash.

Methods of analysis: 1. *Mechanical analyses:* Pretreatment and dispersion were affected according to the recommendations of the International Society of Soil Science (Wright 1939) followed by pipette sampling for silt and clay fractions. 2. *Potash* was estimated volumetrically by the cobaltinitrite method (Wright 1939).

Experimental Results: Mechanical composition of the soil is recorded in table 1 and potash fixing capacity in table 2.

TABLE 1

Mechanical composition of the soil

	Manured			Unmanured		
	0 —6"	6" —1'	1' —2'	0 — 6"	6" —1"	1' —2'
Clay	13·35	21·45	29·33	13·84	20·17	26·63
Silt	20·10	21·90	21·22	21·54	22·50	22·88
Sand	66·00	55·60	47 90	63 84	56·15	48·75

TABLE 2

Potash-fixing capacity of the various fractions as K_20 in mgm.

	Manured				Unmanured			
	0 —6"	6" —1'	1 —2'	Mean	0 —6"	6" —1'	1 —2'	Mean
Clay	4·63	7·56	8·79	6·99	5·29	7·29	8·92	7·16
Silt	8·77	4·73	7·17	6·89	10·70	3·96	5·04	6·56
Sand	0·26	0·22	0·30	6·26	0·37	0·31	0 31	0·33

The data in table 2 indicate that potash fixing capacity is not restricted to the clay fraction alone; on the contrary, the surface silt fraction of plot has shown greater potash fixing capacity than the surface clay fraction. Potash fixing capacity of clay for the manured plot varies from 4·6 to 8·8 mg %. Silt fraction has a large potash fixing capacity and is on the average 6·89 mg % for the silt of the manured soil and 6·56 mg % for unmanured soil. Potash fixing capacity of sand, however, was found to be very small in both manured and unmanured soils. When these different fractions are compared amongst themselves for potash fixation from both the soils it will be noticed that the clay, silt and sand of the unmanured soil has greater potash fixing capacity.

From the mechanical analysis in table 1 and the corresponding potash fixing capacity in table 2 the contribution from the various fractions, deviod of organic matter, has been calculated. These calculated values along with the potash fixing capacity of the original and H_20_2 treated soil are shown in table 3.

TABLE 3

Calculated potash fixing capacity of the soil and the contribution of different fractions free of organic matter in mg. %

	0 —6"	6" —1'	1' —2'	0 —6"	6" —1'	1' —2'
A. Untreated soil	1·271	1·662	3·428	2·306	1·637	2·848
B. Soil after oxidation of O. M. with H_20_2	2 091	2 240	3·820	2·963	2·057	3·078
C. Clay	0·618	1·622	2·577	0·732	1·467	2·376
Silt	1·762	1·035	1·522	2·305	0·891	1·154
Sand	0·170	0·137	0·142	0·238	0·176	0·151
Total from primary particles	2·550	2·794	4·241	3·275	2·534	3·681
D. K-fixing capacity of soil if clay is the only active fraction	0·618	1.622	2·577	0·732	1·467	2·376

It is interesting to note from the data in table 3 that the potash-fixing capacity as found by actual analysis (B) is lower than the sum of the calculated potash-fixing capacity of the different fractions (C). This difference between the two values though small, is still significant; this may be due to the interaction between the different minerals present in the sand, silt and clay lattice.

Potash-fixing capacity of the surface layer of the untreated and H_2O_2 treated soil of the unmanured plot is greater than that of the manured one. This may be due to the inhibitive action of organic matter on potash-fixation as indicated before. By comparing the figures in table 3 for the untreated soil (A) and H_2O_2 treated soil (B), the depression due to organic matter on potash-fixation is more clearly brought out. All the values for (B) are greater than the corresponding values for (A).

The decrease in potash-fixing capacity due to organic matter is expressed as the difference between the potash-fixed before and after H_2O_2 treatment of the soil. For the manured plot the value lies between —0·39 to —0·82 mg % and for the unmanured plot between —0·23 to —0·65 mg %. This agrees with the observations of Worsham and Sturgis (1942) who observed an adverse effect of organic matter on potash fixation by 6 to 4·1 p.p.m. i. e. 0·5 to 4·1 mg %.

When allowance is made for the potash-fixing capacity of sand, silt and clay in the potash-fixing capacity of the untreated soil, a value is obtained which is expressed in table 4 as the potash-fixing capacity calculated from primary particles (Y). Neglecting the potash-fixing capacities of silt and sand and assuming that fixation occurs only in clay the value obtained is expressed as potash-fixing capacity of the organic matter (Z). If the entire potash-fixing capacity were due to clay alone, the potash-fixing capacity of organic matter should have been positive, but apparently this is not the case as is seen from tables 4 and 5.

TABLE 4

Decrease in potash-fixing capacity due to organic matter in mgm per 100 gm soil

		Manured			Unmanured		
		0—6″	6″—1′	1′—2′	0—6″	6″—1′	1′—2
Org. carbon in soil		0·448	0·224	0·194	0·251	0·213	0·182
* Org. matter in soil		0·771	0·385	0·334	0·432	0·366	0·313
X	A—B	—0·820	—0·578	—0 394	—0·657	—0·420	—0·230
Y	A—C	—1·279	—1·132	—0·813	—0·969	—0·879	—0·833
Z	A—C	0·653	0·040	0·851	1·574	0·170	0·472

* (organic carbon X 1·72 = Organic matter)

The values denoted by X and Y in table 4 are greater for the manured plot than for the unmanured. This indicates some relationship between the organic matter content and depression in the potash-fixing capacity. When items X, Y and Z in table 4 are expressed on 100 gm. organic matter as in table 5, a clearer picture of the decrease in the potash-fixing capacity due to organic carbon is obtained.

TABLE 5
Potash-fixing capacity in mgm per 100 gm of organic matter

	Manured			Unmanured		
	0—6″	6″—1′	1′—2′	0—6″	6″—1′	1′—2′
Soil after H_2O_2 treatment	—106	—150	—111	—152	—115	—74
If clay is the only active fraction	85	10	255	364	46	151
From primary particles	—166	—295	—243	—224	—246	—266

The values recorded for H_2O_2 treated soil and those derived from the sum of the primary particles are negative ranging between —74 to —150 mg%. These values do not conform to the figures for potash-fixing capacity of organic matter after removal of the organic matter by H_2O_2 oxidation and after assuming clay to be the sole active agent. It is only after allowing for the contribution for potash-fixation by sand, silt and clay also, that we obtain figures (shown as from primary particles in table 5) which appear more correct.

When the potash-fixing capacity of the untreated soil was studied with the same concentration of potash as di-potassium phosphate as in the previous experiment, it gave a different result. Table 6 gives the result of potash-fixation by di-potassium phosphate. Similar figures for potassium chloride treatment are included for comparison.

TABLE 6
Effect of anion on potash-fixing capacity of soil in mgm%

	Manured			Unmanured		
	0—6″	6″—1′	1′—2″	0—6″	6″—1′	1′—2′
KCl	1·271	1·962	3·428	2·309	1·637	2·845
K_2HPO_4	1·834	2·405	4·565	3·654	2 397	4·053

The data in table 6 indicate that a larger part of the potash was fixed when added as phosphate than when it was added as chloride as observed by De Turk, Wook and Bray (1943), Sturgis and Moore (1939) and Raney and Hoover (1947) who obtained 1½ to 2

times greater fixation of potash when applied as dipotassium phosphate than when applied as potassium chloride. This has been attributed to the linkage of phosphate-ion with some of potash-ion to the colloidal particles, besides its absorption by the replacement of OH ion of the clay colloid. Hence the association of potash-ion in di-potassium phosphate resulted in increasing the amount of potash fixed by nearly 1½ times as compared to chloride.

Discussion: The earlier concepts of soil activity were for the most part, based upon analyses of, or experiments with, the whole soil. It was only clay, besides organic matter, which has long been considered to take part in the fertility of soil. The coarser silt and sand fractions were considered until recently as almost inert. But the potash-fixing capacity of the coarser particles of the soil, particularly silt, and mechanical analysis which shows on an average 20–60% of silt and sand in the soil respectively, suggest that silt and fine sand fractions can now no longer be ignored in assessing the total activity of soils.

From the practical and economic point of view, the question naturally arises as to what is the value of potash that has been fixed in the soil. Fixation interferes with the immediate utilization of potash fertilizers by crops. Not all of the potash applied to the soil is ordinarily taken up by the first crop, and fixation, therefore, decreases the loss of unused potash in drainage water. This protection against leaching following large potash-application, is a certainty. Application of heavy doses of potash results in the building up of the colloid held potash reserve which is a reservior from which supplies of available potash for crop production are derived year by year. According to Seatz and Winters (1943) the exchangeable potash remains in equilibrium with potassic soil minerals and that when the degree of potash saturation of the colloids is altered by manuring and cropping, it tends to be fixed and released respectively.

Summary: Potash-fixing capacity of the soil, original and H_2O_2 treated, and its mechanical fractions was tested. It was found out that all the three mechanical fractions showed potash fixation. The silt fraction showed a higher potash fixing capacity which was as high as that of clay. On the surface greater activity was shown by the unmanured plot than the manured one. Potash fixing capacity of H_2O_2 treated soil was higher than the untreated soil. It was also observed that the soil showed greater potash fixation when it was applied as potassium chloride.

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Seed Treatment against Black Arm Disease of Cotton

by

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Introduction: Black arm or angular leaf spot or bacterial blight of cotton caused by *Xanthomonas malvacearum* (Smith) Dowson, has been prevalent in the Madras State for over thirty years (Ramakrishnan 1950). Primary infection is mainly through the seeds. Rain combined with heavy winds (rainstorms) helps in the spread of the disease (Andrews 1936, Brown 1941). Control of primary infection of black arm by seed treatment has been attempted in several countries with varying degrees of success. Seed disinfection with formalin (1 : 100) has been found to be very effective in theU.S.S.R. (Verderevski 1937). Ceresan materially increased the seedling emergence and yield of cotton in various localities in Texas, at the same time reducing the incidence of angular leaf spot (Smith et al 1936). Massey (1937) has found that the use of mercurial dusts like Abavit B, ethyl mercury phosphate, ethyl mercury iodide, phenyl mercury acetate and several others gave satisfactory control of black arm in Africa. Seed treatment with mercuric iodide had resulted in the control of black arm in the Sudan (Clouston and Andrews 1938). Macdonald et al (1947) have stated that delinting with sulphuric acid and the removal of floaters have resulted not only in the reduction of primary infection of black arm but also improved the germination and vigour of the seedlings. Ramakrishnan (1950) used formalin as steep and dust, Ceresan and Agrosan GN as seed dressings and observed that all these gave protection from primary infection. Tarr (1953 a, b, c) after the use of several seed dressing agents found that mercuric iodide gave better protection as a steep than as a dry dressing. Tarr has further observed that slurry methods were most effective when applied to acid delinted seeds and that soluble organomercury compounds were preferable for slurry methods. Acid delinted seeds were much more susceptible to mercury injury than fuzzy ones. Cuprous oxide was also found to be a promising seed dressing for the control of black arm. (Tarr 1953 a).

Several seed dressings are being put on the market from time to time and in order to test their relative efficacy in comparison with organo-mercurials like Agrosan, Ceresan etc., a series of experiments were conducted both in the field and under greenhouse conditions. A brief outline of the results obtained in these experimentsis presented in this paper.

Materials and Methods: Seeds of MCU 1. cotton, were artificially inoculated with the pathogen by soaking the seeds in a suspension of bacteria for one hour and drying in the shade. They were then treated with various seed dressings for fifteen minutes at 1 : 150 by weight. Care was taken to ensure a thorough mixing of the fungicide with the seed so as to obtain a uniform coating of the substance on the surface of the seed. Delinting was done by using concentrated sulphuric acid at the

rate of 1 lb. of acid for 12 lb. of seed. The requisite amount of sulphuric acid was added little by little to the seeds kept in a mud or procelain container constantly stirring the seeds for about 15 minutes. These seeds were washed free of sulphuric acid in three changes of cold water and dried in the sun. The floating seeds were removed while washing and tested separately. In the case of the pot experiments the number of replications varied from 3 to 5 and in each replication (seedling pan) 30 to 50 seeds were sown. Records of germination and percentage of primary infection were maintained. In addition, the vigour of the seedlings was assessed by recording their linear growth. The results were subjected to statistical analysis. Experiments were conducted under both greenhouse and field conditions.

Observation: In one series Agrosan GN, Fernasan, Y.F. 2776 and Perenox were used. The percentage of germination and primary infection in this experiment are given below:

TABLE I
Percentage of germination and primary infection

Treatment	Percentage of germination	Percentage of primary infection
Agrosan GN	82	12·2
Fernasan	69	24·6
Y. F. 2776	70	55·7
Perenox	73	61·6
Control	75	68·6

From the above it is evident that Agrosan GN and Fernasan have effectively reduced primary infection. Further, Agrosan GN has given a higher percentage of germination over control. The other fungicides were found to be more or less on a par with the control. It has been reported from Africa (Annual Rept. of the Emp. Cott. Gr. Corpn. 1952) that copper compounds not only reduced the primary infection but also increased vigour, yield etc. But from the above experiment it is clear that the copper fungicide Perenox does not afford sufficient protection against primary infection and is only on a par with the control under greenhouse conditions.

In order to confirm the findings with regard to germination and vigour, other experiments were conducted in pots using Agrosan GN and Perenox. The seeds after treatment were sown in pots

TABLE II

Germination Percentage in the Various Treatments on the 8th Day After Sowing

(Lay out—Split-plot Design)

Dates of Sowing	25th May 1953				10th June 1953				30th July 1953			
Main treatments / Sub treatments	Agrosan GN	Perenox	Control	Mean	Agrosan GN	Perenox	Control	Mean	Agrosan GN	Perenox	Control	Mean
	(a)	(b)	(c)		(a)	(b)	(c)		(a)	(b)	(c)	
A. Acid-delinted seeds—SINKERS ..	82·50	76·50	90·00	83·34	90·00	92·66	95·34	89·34	90·63	96·30	96·30	94·38
B. Acid-delinted seeds—FLOATERS ..	51·00	44·50	41·50	45·66	64·00	47·34	49·34	43·56	62·50	66·25	71·25	66·68
C. Acid delinted seeds without removing floaters ..	69·50	71·50	66·50	69·16	72·66	56·00	61·34	63·34	80·00	85·63	81·25	82·30
D. Fuzzy seeds (Control)..	67·00	74·50	65·50	72·34	74·66	61·34	66·00	67·34	89·58	88·75	85·00	87·70
E. Fuzzy seeds treated with cowdung ..	—	Not included		—	—	Not included		—	82·50	71·25	76·25	76·65
F. Fuzzy seeds treated with red earth ..	—	Not included		—	—	Not included		—	80·63	79·38	73·13	77·73
Mean ..	70·00	66·76	66·12	—	75·33	61·84	68·00	—	81·78	81·25	80·52	—

	25th May 1953	10th June 1953	30th July 1953
Main treatments—Conclusions	Significant—C. D. = 6·60 A, D, C, B	Signicant—C. D. = 14·0 A, D, C, B	Significant—C. D. = 10·88 A, D, C, F, E, B
Sub treatments—Conclusion	Not significant	Significant C. D. = 6·80 a c b	Not significant

TABLE III

Mean Length of Seedlings in Centimeters on the 8th Day After Sowing
(Lay out—Split plot design)

Date of sowing	25th May 1953				10th June 1953				30th July 1953			
Main treatments / Sub treatments	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean
	(a)	(b)	(c)		(a)	(b)	(c)		(a)	(b)	(c)	
A. Acid-delinted seeds SINKERS ..	7·95	6·45	7·37	7·26	6·43	7·07	8·20	7·23	6·65	6·28	6·08	6·34
B. Acid-delinted seeds FLOATERS ..	6·80	6·14	5·47	6·14	7·47	6·23	5·70	6·47	5·50	4·80	5·08	5·13
C. Acid-delinted seeds without removal of floaters ..	7·41	6·05	6·20	6·55	6·33	5·13	6·17	5·88	5·73	5·23	5·75	5·57
D. Fuzzy seeds (Control)..	7·95	7·04	6·14	7·04	7·73	5·87	6·13	6·58	6·75	5·78	5·73	6·08
E. Fuzzy seeds treated with cowdung ..	—	Not included		—	—	Not included		—	6·55	5·50	5·25	5·77
F. Fuzzy seeds treated with red earth ..	—	Not included		—	—	Not included		—	5·85	5·55	5·75	5·72
Mean ..	7·53	6·42	6·29	—	6·99	6·08	6·55	—	6·78	5·52	5·60	—

	25th May 1953	10th June 1953	30th July 1953
Main treatments—Conclusions	Significant C.D. = 0·62	Significant—C.D. = 0·77	Significant C.D. = 0·53
	A, D, C, B	A, D, B, C	A, D, E, F, C, B
Sub treatments—Conclusions	Significant, C.D. = 0·66	Significant—C.D. = 0·58	Significant C.D. = 0·34
	a, b, c	a, c, b	a, c. b

containing washed sand. The seedlings were removed on the eighth day after sowing, their number counted and length measured. Here also, acid delinted and fuzzy seeds were utilised. The data on germination percentage and length of seedlings are given in tables II and III respectively.

It is clear from these tables that acid delinted sinkers always gave the maximum percentage of germination. Among the seed dressings Agrosan GN treated seeds gave the highest germination percentage and in one experiment this treatment was significantly superior to Perenox and control while Perenox treated seeds sometimes even produced lesser number of seedlings than the control. As regards the length of seedlings again, acid delinted sinkers produced the tallest seedlings. These findings are in keeping with the observation of Macdonald et al (1947). Among the seed dressings, Agrosan GN again gave significantly taller seedlings in two experiments, thereby indicating that Agrosan GN not only gave protection from primary infection but also induced the germination and vigour of the seedlings.

It is the general practice with ryots to treat cotton seeds with cowdung or red earth and dry them prior to sowing to facilitate easy separation of the seeds while sowing. In order to test the effect of these treatments, an experiment was conducted with graded doses of cowdung and red earth made into a paste with the minimum quantity of water required for thorough mixing with the cotton seed and sun-dried before sowing. The percentages of germination are given in table IV.

TABLE IV

Treatments				Germination percentage
Cowdung:	Cotton seed	1 : 3	by weight	66·4
do.	do.	1 : 6	do.	75·2
do.	do.	1 : 12	do.	80·4
do.	do.	1 : 24	do.	91·6
Red earth:	Cotton seed	1 : 3	do.	67·6
do.	do.	1 : 6	do.	69·2
do.	do.	1 : 12	do.	60·0
do.	do.	1 : 24	do.	83·2
Cotton seed treated with mere water				95 2
Control (Untreated) MCU 1 seed				94·8
			CD = 16·79	

It is seen from the above data that cow dung at strengths 1 : 12 and below and red earth at 1 : 24 did not affect the germination

capacity, while higher proportions impaired the germination to a marked extent.

In another experiment combinations of Agrosan GN with red earth and cow dung were used for treating the seed. The results are given in table V. Only fuzzy seeds were used in this experiment.

TABLE V
Percentage of germination and primary infection

Treatments			Germination	Primary infection
1. Agrosan GN	1 : 150	..	87	3·4
2. Agrosan GN	1 : 300	..	86	1·2
3. Agrosan GN	+ red earth	..	83	6·0
4. Agrosan GN	+ cowdung	..	74	6·8
5. Red earth	+ Agrosan GN	..	85	9·4
6. Cowdung	+ Agrosan GN	..	75	4·0
7. Cowdung alone		..	83	10·8
8. Red earth alone		..	87	11·5
9. Fuzzy control		..	82	9·8

In treatments 3 and 4 the seeds were first treated with Agrosan GN and then with cowdung or red earth. In treatments 5 and 6 the seeds were treated first with cowdung or red earth and then with Agrosan GN. It is seen from the above that treatment with cowdung and red earth alone have not reduced primary infection while Agrosan GN has reduced the infection.

Field experiments were also conducted in 1952-53 season using Agrosan GN. Fernasan, Tritisan and Y. F. 2776 as seed dressings. Artificially infected MCU 1 fuzzy seeds were used for the experiment. The percentage of primary infection in the various treatments were recorded and are tabulated below :

TABLE VI
Percentage of primary infections in the various treatments

Treatment	% Primary infection
1. Agrosan GN	15·25
2. Tritisan	38·75
3. Y. F. 2776	18·13
4. Fernasan	5·13
5. Control	36·63
CD = 14·84	

The results were found to be statistically significant. Fernasan, Agrosan GN, and Y. F. 2776 were superior to control in reducing primary infection.

Conclusions : From the results of the foregoing experiments it is clear that indiscriminately heavy doses of cowdung and red earth have an adverse effect on the germination capacity of the cotton seeds and as such have to be avoided. Red earth at the strength of 1 : 24 and cow dung at 1 : 12 and below did not have an adverse effect on germination. The advantages of using acid-delinted sinkers

instead of cowdung or red earth treated seeds are:— (i) the former ensures more uniform, quicker and higher germination with better vigour of seedlings, besides facilitating easy separation of the seeds, and (ii) the cost of treatment with sulphuric acid works out only to Re. 1/- per acre and this is a negligible sum when compared to the benefits accruing from the treatment. In places where acid-delinting is found difficult, seed treatment with Agrosan GN will be of much use, as the latter also increases the germination capacity of the seed as well as the vigour of seedlings besides reducing seed-borne infection of black arm.

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Recent Developments in the Chemical Method of Pest Control

by

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Introduction: It is a well-known fact that on an average about ten percent of the produce is lost by the cultivators every year due to depredations of crop pests. Intensive research has been in progress in the Madras State for the past four decades on insecticidal methods of pest control. Based on the results obtained so far, an attempt is made in this paper to give an account of the pesticides that can be adopted in plant protection, their peculiarities and adverse effects, dosages and concentration, etc., for the benefit of agriculturists and horticulturists.

Older Insecticides: A certain amount of basic knowledge on the habits of insects is necessary for the judicious application of these pesticides. Calcium arsenate and lead arsenate come under the category of stomach poisons and are in use even at the present day against insects which, while remaining outside, bite and feed on different parts of the plants. These are applied as sprays at the rate of half an ounce of the chemical mixed with one ounce of air-slaked lime in a gallon of water. Calcium arsenate is also used as a dust after mixing one pound of the chemical with four pounds of lime. Generally soap and sulphur combinations are not compatible with the arsenates. The contact insecticides in vogue against aphids, jassids, thrips, etc., include crude oil emulsion and Fish oil rosin soap which are used at a concentration of one pound in six to eight gallons of water. The latter formulation is effective even against hairy caterpillars. Tobacco, which is also a contact insecticide, is used either as a water extract with the addition of some soft soap at the rate of half an ounce per gallon of the spray fluid or dust and is a specific against aphids and thrips.

Synthetic Insecticides: These chemicals (organic compounds), synthesised soon after World War II, come under two broad categories—Chlorinated hydrocarbons and Organophosphates. An interesting feature about these formulations is that they show a combination of contact as well as stomach action. To a certain extent a few of them also possess a fumigant action.

I. **Chlorinated Hydrocarbons:** (a) *DDT (Dichloro diphenyl trichloro ethane):* This chemical has a high residual action and is a specific against certain categories of insects viz., jassids and cutworms. DDT is comparatively slower in action and a distinct reduction in the pest population will be perceptible only in the course of 48 hours after treatment. This insecticide has only a feeble action against grasshoppers

and is ineffective inert against plant lice, coccids and mites. DDT has been found to stimulate plant growth in the case of brinjal, cruciferous vegetables, sugarcane, groundnut, tobacco and cotton.

There are also instances where an indiscriminate use of this chemical has brought in its wake a secondary infestation of mites, aphids and coccids. This phenomenon is due to the lethal action of the chemical against the parasites and predators of crop pests. A certain amount of foliage injury has also been noted on curcurbitaceous plants as a result of application of DDT. Particular care has to be taken in the treatment of fruit trees like limes, lemons, etc., where there is the risk of a greater absorption of the chemical by the oil present in the outer peel of the fruits.

The standard concentrations in use in plant protection (available under various trade names such as 'Guesarol', 'Didimic', 'Hexamar DDT' etc.) are the 5 and 10% dusts and 50% wettable powder. The dusts are applied as such while the spray fluid is prepared by mixing one ounce of 50% wettable powder in three gallons of water,

(b) *Technical BHC (Benzene hexachloride):* This chemical has got a quicker knockdown effect than DDT. To a certain extent it has a fumigant action also. The vapour pressure of BHC is considerably higher than that of DDT and as such the residual action of the former chemical is of a shorter duration. BHC has proved quite effective against a variety of crop pests which are external feeders. Repeated applications have also given a certain degree of relief against tissue borers. This chemical has a few advantages over DDT. The chronic toxicity of BHC is much less than that of DDT and even from the point of view of the persistence of insecticidal residues the former is safer as the highly toxic 'gamma isomer' is reported to disintegrate rapidly.

The injudicious use of this chemical has been noted to bring about a phytocidal action by way of leaf-scorching or stunted growth. The plants belonging to the family *Curcurbitaceae* are highly sensitive to this chemical and as such it would be safer to avoid its use in this case. Another serious disadvantage with technical BHC is that the taint of the chemical is imparted to the produce of the treated plants, especially fruits, vegetables and tuber crops. These adverse effects have been attributed to the *alpha* and *beta isomers* and the impurities present in technical BHC. As a soil insecticide at higher concentrations it affects the germination of seedlings.

As in the case of DDT, this chemical (available under trade names such as 'Gammexane', 'Benexide', 'Klortex', 'Hexamar BHC', 'Lethal rock BHC', etc.) is used as a dust at 5 and 10% concentrations. The dilution of the spray fluid in this instance is generally based on the gamma isomer contents, the strength of 50% wettable powder being 6·5% gamma. On this basis it has been worked out that 1¼ oz. of the chemical in one

gallon of water will give 0·05% (gamma) spray. Higher concentrations of the dusts and spray may be used against hardy insects.

(c) *Lindane:* This product is a purified preparation of technical BHC built up with pure gamma isomers. The insecticidal efficacy of this preparation is on a par with that of technical BHC. The advantage in this chemical is that it may be applied even against pests of fruits and vegetables without fear of ruining the palatability of the produce. The formulation can also be applied judiciously against cucurbits. Lindane is available as dusts and wettable powders, the standard ones in use being 0·64 and 1·3% dusts and 6·5% wettable powder. The dusts can be applied as such while the spray fluid is prepared on the lines indicated against technical BHC.

(d) *Toxaphene (Chlorinated camphene):* It has the quicker knockdown effect of BHC but shows residual action for a considerable time as in the case of DDT. It possesses a combination of the insecticidal action of both the chemicals and may, therefore, be used to act on behalf of the two pesticides. In the case of a combined infestation of aphids, jassids, thrips and caterpillars which is a common feature in cotton, this pesticide has given very convincing results. Toxaphene is highly toxic to cucurbits but does not interfere with the viability of the seed material when used as a soil insecticide. The chemical is available as dust at 10% and 20% and in wettable forms also. The spray fluid may be applied at 0·1% concentration (i. e. one ounce of cent per cent Toxaphene in 6¼ gallons of water).

(e) The other formulations coming under this category which are still in the experimental stage in this State are Chlordane, Aldrin, Dieldrin, Endrin and Isodrin. The first chemical is highly phytotoxic against cucurbits and there appears to be nothing spectacular even as regards its insecticidal efficacy. The other formulations have a high insecticidal action besides being free of phytotoxic hazards, even against cucurbits when applied as a spray.

II. **Organophosphates:** These formulations are highly posionous and have to be handled with the utmost care. An account of the more important pesticides coming under this category is furnished below. It is also a strange coincidence that these chemicals are effective against those groups of insects for which the Chlorinated hydrocarbons are not of much avail.

(a) *Hexa-ethyl-tetra-phosphate (HETP):* As a spray at 0·1% concentrations (i. e. one ounce in 6¼ gallons of water) this chemical is particularly effective against aphids and thrips. In the case of hardier types of insects like mealy bugs and coccids a higher concentration of 0·2% may be necessary. It rapidly hydrolyses to non-insecticidal compounds and can, therefore, be used without fear of toxic hazards even in the case of vegetables. It is compatible with lime and Bordeaux mixture.

(b) *Tetra ethyl pyrophosphate (TEPP):* This is the main active insecticidal principle in HETP also. TEPP has a longer residual action and research on the adaptability of this chemical is still in progressl Malathion is yet another product coming under this category which is stil· in the experimental stage.

(c) *Parathion (Diethy-nitrophenyl thiophosphate):* This is a formulation much more powerful than HETP and is designed to give a greater persistence on the treated plants. It is used at a concentration of 0·025% (i. e. one ounce of 20% Parathion in five gallons of water—available under trade names such as 'Ekatox-20', Folidol E. 605, etc.) and has a contact as well as fumigant action. The chemical is effective against hairy caterpillars and coccids. Encouraging results have been obtained even against the paddy stem borer — *Schoenobius incertellus W.* This chemical is not compatible with alkalies and Bordeaux mixture. The application of the chemical may be stopped a month prior to harvest.

Another interesting development in pest control is the synthesis of what are known as '*Systemic insecticides*'. When applied either to the soil or on the plants, these formulations are absorbed and translocated to the different parts of the plants along the cell sap rendering the latter toxic to certain groups of insects. Further they are retained by the plants for a considerable time (about four to five weeks under Indian conditions) and do not exhibit any lethal action on the natural enemies of these pests. These chemicals also come under the category of organophosphates (represented by Schradan, Sytam and Tetrax). A few other formulations represented by B.F.P.O. and Isopestox come under the category of Fluorohydrins. The investigations so far conducted have indicated their usefulness only against aphids, mites and a few species of mealy bugs when applied at a concentration of 0·075%.

Rodenticides: Zinc phosphide baits have given spectacular results against rodents. The bait is prepared by mixing one part of the poison with 49 parts of a suitable base like popped rice with the addition of a few bits of onions to render the bait more attractive. It would be advantageous to expose the unpoisoned food for a couple of days and follow it up with poisoned baits. As the chemical is highly poisonous to human beings and domestic animals, great care should be taken in its use. The latest rodenticide - Warfarin (Dethmor) has also given encouraging results against migrating rats and investigations on the baiting technique are in progress.

Acaricides: The incidence of mites is fairly common on horticultural and agricultural crops. Application of sulphur either as a dust or spray (at one pound of the wettable powder in 20 gallons of water — available under trade names, viz., "Sofril", "Thiovit", etc.) has been found to give considerable relief.

Conclusion: Before concluding the account on the developments in the insecticidal methods of pest control, it has to be mentioned that notwithstanding the synthesis of some of the more potent insecticides, the problem of the control of tissue borers still remains unsolved. There is a need for an effective insecticide which will get into the texture of the plants and cause the death of these internal feeders without in any way proving detrimental to the human beings or domestic animals consuming the produce of the treated plants.

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The Condition Factor for Paddy and the Irrigation Facilities available in certain Districts of Madras State during the last Fifty Years

by

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Introduction: The estimate of output of any crop for each district in a given year is the product of three factors, namely (1) the area under the crop in that year, (2) the normal yield per acre and (3) the condition factor for that year. The area under the crop is compiled every year by village officers based on the actual area sown to that crop in each holding. So far as the normal yield per acre for paddy is concerned, this was worked out by the Director of Agriculture, Madras in the year 1919 for each district. This figure is continued to be adopted since then and upto 1949 - '50. The condition factor (or the seasonal factor as it is also called) is the percentage of the normal yield estimated to be obtained each year. If the season is normal in any year, the normal yield can be expected and therefore the condition factor for that year is expressed as 100. Conditions of drought, floods, incidence of pests etc., affect the yields. The village officers furnish every year their estimates of what percentage of the normal yield is expected from their villages. Based on these estimates and the area under the crop in each village, the average condition factor is calculated for each district. According to the Season and Crop Report for Madras State for the year 1951 - '52, the total

normal area under paddy in the thirteen districts comprising the Madras (Residuary) State is 5,951,130 acres and the normal output of paddy is 3,604,140 tons. Six districts have been chosen for the present study and they differ widely in soils, paddy seasons and the available irrigation facilities. These districts account for 64·4 percent of the total normal area and 66·1 percent of the total normal output of paddy in the Madras State.

Soils and paddy seasons: In Table I, the main features of the districts from the point of view of soils and paddy-growing seasons are given:

TABLE I

Soils and Paddy-Growing Seasons in the Selected Districts

District selected	Nature of soils in which paddy is grown	Main sowing and harvest seasons for paddy
South Arcot	Black clay and black loam	In 65% of the paddy areas, sowings are done between September and November. Harvests come off in January to March.
North Arcot	Black loam and red loam	Under wells, sowing is done in July—August (15·7% of the paddy area). In 51·5% of the area sowings are done in September to November. These receive water from tanks. Harvests are done in the above areas in November—December and February to April respectively.
Tiru-chirapalli	Alluvial and regar	In 70·7% of the areas sowings come off in September to November. Harvests come off in January to March.
Tanjore	Alluvial and regar	Over 90% of the sowings come off in August to November. The harvests are done in January to March.
Tirunel-veli	Black loam	In lands which receive water from freshes in the river (20%) sowings are done in June—July and harvests in September—October. In lands commanded by tanks (63%) sowings are done in November to January and harvests in February to April.
Malabar	Red ferruginous	In 58% of the lands sowings are done during the south-west monsoon in May to July and harvested in September—October. Another 19% of the lands are sown in October and harvested in January—February.

It is seen that the paddy soils in Tanjore and Tiruchirapally are more nearly alike while those in other districts differ from one another. Sowings and harvest seasons are roughly alike in South Arcot, Tanjore and Tiruchirapalli. In the remaining districts these seasons differ.

TABLE II

Area Irrigated and the Acreage and Output of Paddy in Certain Districts

District	Year	Total Area Irrigated	Percentage of area irrigated to the Total area irrigated by: Government Canals	Tanks	Wells	Others	Normal Area under paddy 1951—52**	Normal output 1951—52**	Normal yield per Acre
South Arcot	1911—12	514,446	30·8	53·1	13·0	3·2	..	..	..
	1931—32	511,427	28·7	52·8	13·5	5·1	537,250	299,950	1,752
	1951—52	545,355	38·5	34·4	25·7	1·4	(9·0)	(8·3)	..
North Arcot	1911—12	412,959	7·7	69·1	14·5	8·7	..	..	..
	1931—32	408,657	7·1	64·9	23·3	4.6	390,960	243,570	1,832
	1951—52	367,349	5·9	42·4	51·1	0·5	(6·6)	(6·8)	..
Tiruchirapalli	1911—12	328,404	41·4	23·3	32·4	2·9	..	..	..
	1931—32	281,815	43·6	21·8	31·4	3·1	426,160	261,350	1,819
	1951—52	435,353	35·8	37·0	23·6	3·5	(7·2)	(7·3)	..
Tanjore	1911—12	999,795	84·1	14·0	1·6	0·2	..	..	..
	1931—32	953,631	88·0	10·7	1·1	0·2	1,338,560	872,190	1,711
	1951—52	1,213,293	95·1	4·1	0·8	0·2	(22·4)	(24·2)	..
Tirunelveli	1911—12	326,941	15·3	54·3	29·0	1·4	..	..	..
	1931—32	284,716	17·3	55·0	25·6	2·0	320,120	238,070	1,997
	1951—52	345,189	14·5	61·3	23·4	0·7	(5·4)	(6·6)	..
Malabar	..	..	..	..	..	..	823,250	466,000	1,400
							(13·8)	(12·9)	..

** Figures in brackets are the percentages of the total for Madras State.

Irrigation facilities: In table II a picture of the irrigation facilities available in the six districts is also given. The salient features are: (1) Malabar; The paddy areas of this district are exclusively rainfed. (2) Tanjore: In Tanjore a substantial portion of the irrigated area receives water supply through innumerable canals. In 1951–52, over 95% of the irrigated area received canal irrigation and this is 11% more than what it was 40 years ago. The area commanded by tanks is now only 4%. During the last 40 years an additional area of over 2 lakhs of acres has been brought under irrigation. (3) North Arcot: Only 6 to 7% of the irrigated areas receive canal irrigation. Wells which supplied water for 14% of the irrigated area 40 years ago now supply 51% but the ayacuts coming under tanks have decreased from 69% to 42%. The total area irrigated has been declining from 4·13 lakhs acres in 1911–12, to 4·09 lakhs in 1931–32 and to 3·67 lakhs in 1951–52. This seems to indicate that monsoon rains have been decreasing and underground water supplies are failing in that district. (4) South Arcot: Like North Arcot, South Arcot too, has recorded a decline in the ayacut under tanks. The increase in the area under well irrigation in South Arcot is also far less than North Arcot. Portions of South Arcot lying near the Cauvery delta command canal irrigation which accounted for 31% of the irrigated area in 1911–12 and 38% in 1951–52. The total area irrigated in South Arcot has increased by nearly 31,000 areas during the last 40 years. (5) Tiruchirapalli: More substantial is the increase in the area irrigated in this district. During the last 40 years an additional area of over a lakh of acres has received the benefits of irrigation. In 1951–52, 20,000 acres more have received canal irrigation as compared with the area irrigated by canals in 1911–12. The actual ayacut under tanks too has doubled itself in this district but the area receiving irrigation from wells has remained stationery during the last 40 years. (6) Tirunelveli: Over 60% of the irrigated area is commanded by tanks. Government canals supply water only to 15% of the irrigated area and wells to less than 25%.

Putting it briefly, the paddy lands of Malabar depend entirely on monsoon rains and those in Tanjore on canal irrigation. Water supply in North Arcot has been dwindling and about one half of the irrigated area of that district gets water from wells and the rest from tanks. South Arcot and Tiruchirapalli are now almost alike and 1/4th of the irrigated areas of these districts are commanded by wells and one-half of the balance is under the ayacuts of tanks and the other half receives canal irrigation. In Tirunelveli more than half the irrigated area is under the ayacuts of tanks and the balance gets irrigation from wells and from Government canals. The six districts selected for the present study therefore present a wide variety of conditions in soils, in seasons and in irrigation facilities.

Normal acre yields: Since the condition factor is a percentage of the normal yield per acre expected to be actually obtained in any year, it is necessary to take into account the normal yields adopted during the last

50 years covered by the present study. If the normal yields are pitched high, the condition factor will be low since the actual yield will be a smaller percentage than what it will be when a lower figure for normal yield is adopted. The normal yield of paddy as given in the Season and Crop Reports of Madras State of the respective years are given in table III.

TABLE III. Normal yields of paddy. *(In pounds per acre).*

District	1902–03 to 1904–05	1905–06 to 1909–10	1910–11	1911–12 to 1917–18	1918–13 to 1949–50	1950–51 onwards
South Arcot	..	1350	1700	1700	1850	1752
North Arcot	..	1650	1650	1800	1900	1832*
Tiruchirapalli	..	1450	1800	1800	1900	1819
Tanjore	..	1600	1600	1600	1750	1711
Tirunelveli	..	1350	1800	2000	2000	1997
Malabar	..	1350	1400	1400	1400	1400

* In the Season and Crop report for 1950–51 this is given as 1332 whereas in 1951–52 it is given as 1832.

TABLE IV. Frequency Distribution of the "Condition Factor" for Paddy in Certain Districts

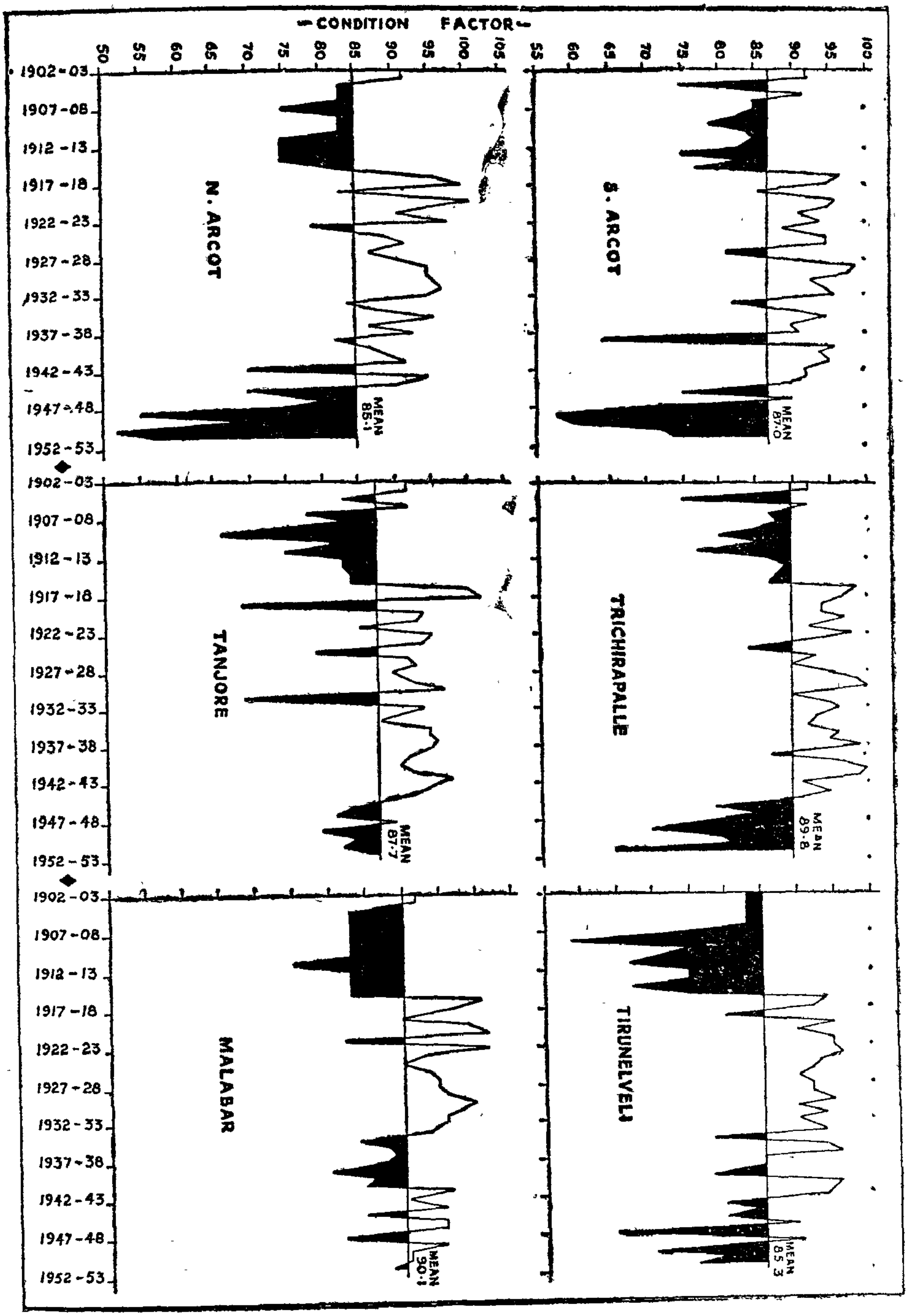
District	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99	100–104	Total	Mean	Standard deviation	Coefficient variation
South Arcot ..	—	1	2	—	3	5	6	5	15	13	—	50	87·0	11·4	13·1
North Arcot ..	1	2	—	—	3	7	11	6	8	10	2	50	85·1	10·8	12·7
Tiruchirapalli ..	—	—	—	—	2	4	4	10	15	14	1	50	89·8	7·7	8·6
Tanjore ..	—	—	—	3	—	4	11	6	16	8	2	50	87·7	8·5	9·7
Tirunelveli ..	—	1	—	3	2	8	9	3	16	8	—	50	85·3	8·8	10·4
Malabar ..	—	—	—	—	—	1	15	7	10	13	4	50	90·1	6·8	7·5
	1	4	2	6	10	29	56	37	80	66	9	300	87·2	10·8	12·4

Condition Factor: In table IV the frequency distribution of the condition factor during the last 50 years for the six selected districts is given. It will be seen from it that the distribution is not strictly normal.

The number of years having a condition factor of 70 and above increases gradually till the 'mode' is reached. The frequency then decreases steeply. The normal yield or anything above it (i. e. the condition factor of 100 and above) has not been met with in any year during the last 50 years in the districts of South Arcot and Tirunelveli. North Arcot and Tanjore each experienced this situaiion in only two out of the 50 years and Tiruchirapalli only in one year. Malabar has been fortunate in having had four years out of the fifty in which the condition factor was 100 and above. This district has not also experienced any year in which less than 75 percent of normal yields were obtained. Tiruchirapalli has not seen a condition factor less than 70 percent and Tanjore less than 65 percent. South Arcot, North Arcot and Tirunelveli have seen very bad seasons in which only 50 to 60 percent of the normal yields were obtained. The mean condition factor for all these districts is between 85 and 90 and the difference in the means for individual districts is not statistically significant. The Coefficient of variation for seasons is the least, namely 7·5 percent in Malabar showing that the conditions in this district are generally uniform. It is highest (13·1%) in South Arcot. For all the six districts together the mean condition factor is only 87·2. The trends of the condition factor for each district are represented in the graph attached. The existence of successive years of bad and good condition factors is revealed in these graphs and they can be grouped as shown below:

(1) About twelve successive years from 1904—'05 to 1915—'16 in which the condition factor was below the mean in all the six districts. (2) About thirty years of above-the-average condition factors from about 1916—'17 to 1945—'46 in all districts except Malabar. (3) Adverse condition factors in all districts except Malabar from 1945—'46 onwards. Till 1951—'52 there was practically no recovery. (4) In Malabar the favourable period was from 1916—'17 to 1933—'34 only i. e. for 18 years. This was followed by seven unfavourable years. This district had again a favourable period from 1941—'42 to 1951—'52 except in three years.

Seasonal conditions do not really seem to have been adverse over successive years during 1904—'05 to 1915—'16. It is therefore difficult to explain why poor condition factors have been recorded in successive years in all the districts upto 1915—'16. Since firm normal yields based on a number of factors such as actual yield at Research Stations, actual crop sampling experiments etc. have been worked out in 1919 and adopted since then it is desirable to ignore the figures prior to 1918—'19. An era of prosperity seems to have dawned from about 1915—'16 and has generally been sustained upto 1944—'45. During this period all districts except Malabar had generally experienced more-than-average seasonal factors. The reasons for adverse conditions in certain years were as below: (1) Submersion of low-lying areas in the Coastal districts such as Tanjore. (2) Inadequate rains in Malabar. (3) Late or inadequate rains in districts which depend on freshes in rivers or in areas commanded by tanks and wells. (4) Excesive rains when crop is advanced in growth.


CONDITION FACTOR
N. ARCOT
S. ARCOT
TANJORE
TRICHIRAPALLE
MALABAR
TIRUNELVELI
MEAN 85·1
MEAN 87.0
MEAN 87·7
MEAN 89·8
MEAN 90·1
MEAN 85 3
1902-03
1907-08
1912-13
1917-18
1922-23
1927-28
1932-33
1937-38
1942-43
1947-48
1952-53
50
55
60
65
70
75
80
85
90
95
100
105

From the graphs it will be seen that during the 'twenties' and the 'thirties', Tirunelveli district has shown no depression in the condition factor. Malabar follows an independent trend. Acute adverse conditions have been experienced in North Arcot from 1945—'46 onwards. This is a district which depends on tanks and wells the water supply in which depend entirely on the receipt in adequate quantities of monsoon rains. It has therefore suffered most, consequent on the continued inadequacy of rains. In the prosperous period of the twenties and thirties the graphs for South Arcot and North Arcot are alike. So also the graphs for Tanjore and Tiruchirapalli. But during the adverse period of the 'forties the graphs for South Arcot and Tiruchirapalli which have similar irrigation facilities now are alike.

TABLE V

Results of crop sampling survey in certain districts of the Madras State

Name of District	Year	Output of paddy in thousands of tons			Remarks
		As per Crop Sampling Survey	As per official estimate	Difference expressed as %age of col. 3	
(1)	(2)	(3)	(4)	(5)	(6)
1. South Arcot	1949—50	350·8	245·9	—30	
	1950—51	311·9	253·0	—19	
	1951—52	346·2	273·8	—21	
	Average	336·3	257·6	—23	
2. North Arcot	1949—50	270·2	242·9	—10	
	1950—51	247·7	127·5	—49	
	1951—52	156·7	155·2	— 1	
	Average	224·9	175·2	—22	
3. Tiruchirapalli	1949—50	307·5	305·6	— 1	
	1950—51	350 8	288·2	—18	
	1951—52	271·6	266·2	— 2	
	Average	309·9	286·7	— 7	
4. Tanjore	1949—50	732·8	880·1	+20	
	1950—51	787·9	910·0	+15	
	1951—52	879·0	916·5	+ 4	
	Average	799·9	902·2	+13	
5. Tirunelveli	1949—50	188·0	182·1	— 3	
	1950—51	250·7	222·9	— 8	
	1951—52	222·4	251·1	+13	
	Average	220·4	221·0	—	
6. Malabar	1949—50	373·1	470·0	+26	
	1950—51	397·0	476·6	+20	
	1951—52	403·0	471·7	+17	
	Average	391·0	472·8	+21	

Note:— (1) The figures in Col. 3 have been worked out from the figures of output of rice given in the "Administration Report of the Agricultural Department" for the respective years.

(2) The figures in Col. 4 are from the Season and Crop Report of the respective years.

Discussion and conclusions: This study reveals that anything like the normal yield of paddy has not been obtained over a substantial period during the last half a century, the mean condition factor having been between 85 and 90% in the six districts under study. This shows that the normal acre yields have been pitched too high. In Table V are furnished the estimates of total output of paddy during the last three years in the six districts based on crop sampling surveys and on the condition factors. It will be seen that the official estimates of output in Tanjore and Malabar based on the condition factors have been on the high side during all the three years. In the remaining districts it has been consistently on the low side except in Tirunelveli during 1951 - '52. The average of the three years shows that the output has been over-estimated by 13% and 21% in Tanjore and Malabar respectively and under-estimated by 7% in Tiruchirapalli, 23% in South Arcot and 22% in North Arcot. The average variation for the three years for Tirunelveli is 'Nil'. This seems to indicate that besides pitching the normal yield too high the estimates of condition factors too were put on the high side in the districts of Tanjore and Malabar. In other districts which have a less assured water supply the official estimates of output were more cautious indicating that the estimate of condition factor for each district should be as near as possible. This has not been realised during the last fifty years. This can be achieved only by revising the figures of normal yield to levels which can really be possible of attainment over many years and not something which can be reached in just less than 5 years out of fifty. The fixation of a more realistic figure for normal yields perhaps based on the crop-sampling surveys now in progress seems warranted.

This study has once again brought out the well-known fact that seasonal vagaries can more nearly be overcome in areas which enjoy the benefits of assured seasonal rains and those which enjoy supply of irrigation water from river systems. In a district like Tirunelveli where a substantial portion of the paddy crop matures in the warmer months of February to April the acre yields are the highest.

Annual Report of the Research division, Sudan Government, Ministry of Agriculture, 1950—'51; Pp. 787; one map; McCorquodale & Co. (Sudan) Ltd.; 1953:

The main work was on cotton. Other crops handled are Sorghum, Eleusine, Pulses: Vigna, Pigeon pea, Cicer, Pasture grasses, Rice, Grounduut, Sesamum, Sun-flower etc.

Cotton research in Sudan (1950-51): The activities of the Research Division of the Ministry of Agriculture, Sudan Government during 1950–51 marked the usual progress in cotton research carried out by the different sections in the Gezira Research Farm and at the Shambat station. Several agronomic experiments of a long term nature were in progress in the Gezira Research Farm and the season's results of individual experiments were mostly as per expected indications. Cotton-Lubia *(Dolichoas lab-lab)*—Fallow was the best three course rotation, while Cotton-Lubia was the best two course rotation. There was no significant difference between dates of application or between average responses to different types of nitrogenous fertilizers. There were no significant responses to phosphate or potash in 1950–51. The level of all yields was high and responses to nitrogen large. The residual effect of ammonium sulphate applied in 1947 was well marked in the case of heavy applications like 160 and 240 rotls N/feddan. In a variety–spacing–date of sowing and manuring experiment, analysis of the yields showed that for Sakal and x 1730A, sowing dates in August were significantly better than in September, but for the American Cotton SP. 84, the end of August and September were better than mid-August. Sakal and x 1730 A yielded better than SP. 84. Very close spacing (20 c. m. between plants) significantly reduced yields and nitrogen gave a marked increase.

Considerable plant observation data have been gathered since 1940 from the Gezira observation plots and a tentative analysis of part of the data has been completed.

Work on the nutrition of the cotton plant showed that (1) reducing sugars were higher in the mature seeds of immature bolls, (2) sugars were present in bad lints but not in good lints, (3) and that a positive tannin test was correlated with low nitrogen content in the leaf. Pot experiments with Gezira soil indicated that the effect of phosphate was limited by the nitrogen supply. Limited data from investigations on optimum size of plots suggested, that if the total area of a trial was fixed, the greatest-precision would be obtained by reducing plot size to a minimum and so increasing the number of replication. No significant differences were found in experiments on pretreatment of seed with fertiliser solutions.

The main breeding policy was the production of strains of Sakel and 1730 which would be equal to the existing commercial strains in yield and quality, but be resistant to leaf curl, *blackarm* and *jassids*. The breeding work may be regarded as practically complete as regards *blackarm.* but the introduction of factors for leaf curl and *jassid* resistance was in progress. Blackarm resistant 1730 (BAR XL–1) was grown for the first time on a commercial scale and the yields were fair and grade excellent.

At Shambat, this season had virtually completed the work on *blackarm* resistance and the addition of leaf curl resistance was in progress. A wave of BLR 14/25, almost immune to *blackarm* and moderately resistant to leaf curl was released and further filtering of BLR 14/25 towards increasing its leaf curl resistance was in progress.

In the hybridisation between tetraploid *herbaceum* and Sakel, the *herbaceum blacaarm* resistance gene was successfully carried to the fifth Sakel backcross. B_5, the resistances gene from Grenadines White Pollen and B_7, the resistance gene from Stoneville 20 were successfully carried to sixth and fourth Sakel backcross respectively.

The production of *blackarm* resistance strains of American Upland also engaged attention and the addition of B_3 to Uganda BP-52 strain, already homozygous for B_2 was in progress.

In the *jassid* resistance programme, a blackarm (B_2) resistant and leaf curl resistant Sakel, homozygous for H_1 was synthesised for use as a backcross parent in the hairiness transference.

In the transference of lint strength from *G. thurberi* to Sakel, a number of F_8 lines of *G.* '*thurbadense*', x Domains Sakel were sown and plants with Pressley strength indices upto 10·2 were selected as against 7·7 for the controls.

In the transference of an increased number of locules from *sanguineum*, *herbaceum* and Phillippines Ferguson to Sakel, plants with mean locule number of 3·63 to 3·77 were isolated in different backcross generations.

The section of Entomology carried out studies on the ecology of the cotton jassid (*Empoasca libyca*, de Berg) and found that by eradicating vegetable and weed host plants, the *jassid* populations in gardens could be reduced to unimportant numbers. Experiments on the effectiveness of newer insecticides and spraying by fixed wing aircraft against cotton *jassids* were in progress. (V. S.) [Ed. 1 Feddan = 1·038 acres; 1 Rotal = 0·99 lbs.]

AGRICULTURAL NEWS LETTER, MADRAS

Perennial Fodders and Grass Farming — Introduction: With the ever-increasing population of the country, the strain on the cultivated area is so great that people are tempted to encroach upon forest areas, meadows and pasture lands. This indirectly affects the poor cattle and in particular the milk cows. It is a common experience that cows in milk require green feed to maintain the production of milk and normal health. Since, the main source of green feed viz. Forest areas, meadows and pasture lands are inadvertently encroached upon for cultivation, the requirements of animals have dwindled. This engaged the attention of the scientists and the problem was successfully tackled by isolating a few varieties of perennial grasses. The intensive cultivation of these perennial grasses by suitable manuring and systematic irrigation is really a boon to the ryots.

Details of cultivation of perennial fodders — Soil: Loamy soil with better irrigation facilities and drainage is suited for the cultivation of irrigated grasses.

Preparatory Cultivation: The land is given four ploughings two with iron ploughs and the rest with the country plough so that a proper tilth is obtained. The breaking of clods with mallets may be resorted to, if necessary.

Manures and Manuring: Where there is no facility for sullage or sewage irrigation, well-decomposed cattle manure is applied at the rate of 25 tons per acre, the manure being covered with the country plough. The application of 25 to 50 lb. ammonium sulphate by dissolving it in irrigation water can be resorted to when very rapid growth is desired.

Seeds and Sowing: The soil is then thrown into ridges and furrows made 2½ feet apart with the help of a ridge plough or with human labour. The propagation of perennial grass by seed is found very difficult and wasteful. The best and the easiest method of propagation is by slips. In the case of perennial grasses a portion of the stem with a few roots is known as the slip. Mostly they are tillers produced by the previously planted material. About 20,000 slips will be required for planting an acre. Two slips are planted per hole (to avoid gaps) on the sides of the ridges one foot apart.

Irrigation: Water is let into the channel and the slips are then planted. Life irrigation is given on the third day. The third and the fourth irrigations are given at an interval of 4 days each from the date of the life irrigation. Subsequent irrigations are given once a week.

When permanent grass is to be maintained purely on sullage or sewage irrigation, careful planning is required. Generally sullage water will be available daily and the area to be grown with grasses will have to be determined on the basis of minimum avilability of sullage water per day. Since irrigation is normally given once a week, the area that can be commanded by seven days' supply can be easily be determined. Sullage or sewage irrigation results in sedimentation of organic matter on the land giving rise to sullage sickness. To over come this condition, the sedimentation will have to be scraped out and removed periodically.

After-Cultivation: When the plots get weedy, country plough can be worked in between the rows. Human labour is employed to earth up as well as to remove weeds along the row.

Harvest: The best time for the harvest of grass is just before flowering. If it is too early, the outturn will be affected and if late, the quality of grass deteriorates. The interval between harvest varies with the variety of grasses. The optimum interval for individual grass can be determined by experience. The yield of grass improves from the first cutting and remains at the same level for a period of six months. Depending upon the daily requirement of green fodder, the plot may be divided into strips and the grass cut at suitable intervals, so that the daily supply may be maintained.

Quartering: When perennial grasses remain in the field for a number of years, the clumps become bigger in size due to tillering and the number of dead shoots increases resulting in poor outturns. The crop becomes old and requires rejuvenation. Under such circumstances the grass clumps may be cut into four parts and three parts may be removed leaving the fourth part to develop. In quartering it should be noted that dead shoots are discarded as far as possible.

Comparative trial of fodder grasses conducted on the Central Farm, Coimbatore: Guinea grass and Napier grass were introduced on the Central Farm Coimbatore in the year 1920 and these grasses were raised under sullage irrigation, supplemented with well water mainly for keeping the Dairy herd on green fodder. Water grass was introduced in the year 1947 and the Cumbu X Napier grass was also evolved recently. With a view to study the comparative yields of these grasses an experiment was laid out with all the four grasses under sullage irrigation in the year 1950 which concluded in the year 1953. From the analysis of

the data, it was found that Napier grass gave the maximum yield by giving an average yield of 2,60,000 lb. per acre per year. The next was the Cumbu X Napier grass with an average acre yield of 1,90,000 lb. per acre per year. The details of the experiment are furnished below.

Field No. 70 (Eastern block)

Size of plot: 30 links × 25 links — 0·75 cent.

Date of planting: 23—5—1950.

Lay out: Randomised block.
Application: Six replications.
Treatments: Five.
(A) Napier grass.
(B) Guinea grass.
(C) Cumbu X Napier grass.
(D) Water Grass.
(E) Kolukkattai grass.

Date of harvest: 6—9—1950; 26—10—1950; 17—12—1950; 5—2—1951; 29—3—1951; 19—3—1951; 9—7—1951; 29—8—1951; 24—10—1951; 14—12—1951; 8—2—1952; 29—3—1952; 19—5—1952; 10—7—1952; 31—8—1952.

* The grasses were irrigated with sullage water.

Utility: The introduction of perennial grasses is closely linked up with dairy farming. But in our State the average number of cows and the average holding of irrigable lands possessed by each farmer is so slow that the spread of these grasses has not been appreciable. But however since the "Drink More Milk" campaign has come to stay and the Government and local bodies are anxious to tackle the problem of milk production and supply on a co-operative basis there is immense scope for the spread of these perennial grasses in future.

Sewage cum Dairy Farms: In corporations and big municipalities, the disposal of sewage is a problem and it is often a menace to the health of the population. But this can be utilised to the best advantage by diverting them for raising perennial grasses. This not only reduces the cost of irrigation but at the same time encourages the growth of perennial grasses. The corporations and municipalities that can afford to maintain a dairy, can combine both these aspects, and restrict the numbers of animals to the availability of green fodder and this would go a long way in solving the milk problem.

Maintenance of grass farms by municipalities: In municipalities who cannot afford to maintain a dairy, grass farms can be opened by utilising the sullage or sewage water as the case may be and sell away the produce out right to the consumers at a fixed rate and thus help in augmenting the milk supply in the municipal areas.

Grass Farming on Co-operative basis: The Co-operative milk supply unions formed in many municipalities can take the responsibility of supplying green fodder to its members. They may arrange to run grass farms either with the help of the municipalities or with their own efforts and supply their members with green fodder at a fixed price.

Individual Enterprise: In the Central Farm, Coimbatore, Napier grass and Cumbu X Napier grass have recorded acre yield of 2,60,000 lb. and 1,90,000 lb. respectively. Leaving a liberal margin of 50% for sullage irrigation a ryot can easily get 1,30,000 lb. of Napier grass and 95,000 lb. of Cumbu X Napier grass per acre. The value of these at the rate Re. 1/- per 100 lb. works out to Rs. 1,300/- and Rs. 950/- per acre. Taking the cost of cultivation at Rs. 500/- per acre the ryot can get a net income of Rs. 800/- and Rs. 450/- per acre for Napier grass and Cumbu X Napier grass. When once cultivated, these grasses can be maintained for years, by proper irrigation, manuring and quartering whenever necessary. Thus a ryot can grow permanent grasses and sell them to the consumers and make a decent profit.

Conclusions: There is every chance of the "Drink Milk", campaign being intensified as no equally good "protective food" is available. The perennial grasses will play the most important part in the production of milk. Though individual efforts cannot be completely ruled out, co-operative effort through Government and Local bodies will go a long way in popularising these permanent grasses and thus help to increase the production and supply of milk to the millions who are now so very inadequately fed with this item of food, which is essential for the maintenance of health both in adults and infants. (Director of Agriculture, Madras.)

EXTRACTS AND GLEANINGS

Colchicine Treatment of young seedlings as a means of inducing polyploidy by H. Douwes — Gent: 51. 1952. 7-25. (Ministry of Agriculture, Sudan Government. Mem. Res. Dis. No. 28, 1952.)

Many different techniques of applying colchicine to dividing tissue are in use. The author of the paper deals with the treatment of germinating cotton seed from which the seed coat has been removed before the application of colchicine. In the *Gossypium* removal of seed coat is important as great differences occur in the hardness of seed coat. The wild species have typically hard seed coats and chipping of seed coats is necessary to achieve quick and regular germination. Although the seed of cultivated species normally germinate without chipping, certain strains like 'Demak' belonging to G. *arboreum* race *burmanicum,* from Java, showed irregularities in germination when the seed coats were not chipped. In order to eliminate the variability caused by the hardness of seed coat which affected the speed of penetration of colchicine solution, the removal of seed coat is essential. A correct estimate of the time limit of application and of concentration of solution may then be possible for recommending to *Gossypiums,* as a whole. In case of the cultivated cottons, removal of seed coat with the thumb nail can eassily be achieved after the seeds have been soaked between wet blotting paper for about 24 hours.

The author has reviewed his previous work conducted on cotton with colchicine by Mendes, Harland and others. He distinguishes the growth-stunting effect caused by colchicine treatment as a result of toxic effect from the slow growth rate normally found in tetraploid tissues. While in the latter the growth rate is constant, in the former stunting is proportional to the concentration of the colchicine solution present in the growing tissue. The toxicity affects all seedlings eqaully, whether they have become polyploid or not. This toxic effect diminishes gradually with the last traces of colchicine from the tissue. In measuring the rate of growth shortly after treatment those two causes of delay have not been separated. As the polyploidizing effect of colchicine is bound in time with the rate of cell division, too short an exposure will not have the desired effect. Because of its toxicity, a high temperature during the treatment might therefore

be unfavourable, as death will be caused within a shorter time of exposure. Under tropical conditions with temperatures rising to 45°C. or higher this needs to be considered. The polyploidizing effect of colchicine was judged on the basis of chromosome counts in pollen mother cells and on measurements of stomatal length. Young cotton seedlings were treated in two different ways with colchicine as a means of inducing polyplody. In the first method the seeds were soaked in water for 24 hours and the seed coat was removed and the whole bare embryo directly exposed to colchicine between blotting paper soaked in solution. Two concentrations were used viz., 0·025% and 0·050% in distilled water. At a a temperature of 21—26°C, a 12-hour exposure to 0·025% (12 × 0·025 = doze 0·30) proved to be sub-lethal as also an 8-hour exposure to 0·025% (doze 0·10) or one hour in 0·050% (doze 0·050) on the other side. A great handicap of the technique is the severe secondary toxic effect of the colchicine, especially on the root system, causing a marked check in growth.

In the second technique the seed coat was also removed after about 24 hours soaking in water but the treatment was postponed for 4 days after the commencement of the germination. The advantage of this method is that the root grows longer, enough (i. e. 1 cm. or more) to permit the treatment of the shoot only, by inverting the young seedling with its growing points in a small tube of colchicine solution. This greatly reduced the check in growth. Only 0·050% colchicine was used in this technique and the heaviest treatment given was 10 hours (doze 0·50) at a temperature between 23 and 26°C. By using this method tetraploidy was induced by 2-hour treatment (doze 0·10) upwards. The optimal dosage is likely to be near 0·30 i. e. a six-hour treatment.

It is concluded, that the second technique, where the roots are kept outside the colchicine solution, is to be recommended. With this technique at a temperature between 23 and 26°C. tetraploidy occurred following 2-hour treatment in 0·050% (doze 0·10) upwards. It is not advisable to use weaker concentration 0·025% since the results obtained in the experiments indicated that a treatment of 12 hours or more in 0·025% is more toxic than the same dosage obtained with half the time at double the concentration, while no advantage in efficiency of polyploidizing is obtained. (N. K. I.)

Striga Control: In the Sudan it was found that sorghum yields grain and fodder had gone very low in lands put under continuous cultivation. This low yield was attributed to the poverty of the soils and so the land especially in the tropics must be given periodical rest. In a few such lands put to sorghum and traditionally low yielding it was found that significantly larger yields were obtained by control of *Striga hermontheca* with the help of hormone weed killers. It is not clear whether the poor yields were due to running out of the soil or due to over-parasitisation. (K. Wilson, Sudan. Dept. Agri. and Forest Res. Nature **172**; 128; 1953) (N. K. S.)

CROP AND TRADE REPORTS

Crop Statistics, Madras State, 1953—'54. Tobacco—First forecast: The area sown with tobacco upto 25th December 1953 is estimated at 40,100 acres and shows an increase of 2·0% over the corresponding period of last year due mainly to better seasonal conditions. An increase in area is estimated in the districts of South Arcot, North Arcot, Coimbatore, Tanjore and South Kanara same as last year and a decrease in Madurai, Salem, Tiruchirapalli, Ramanathapuram

and Tirunelveli districts and negligible in the districts of Chingleput, Malabar and the Nilgiris. The crop is reported to be generally satisfactory in all the districts of the State. The yield per acre is expected to be normal in all the districts of the State, except in North Arcot and Madurai where it is too early to report on the yield of the crop. The wholesale price of tobacco per maund of 82–2/7 lb. or 3,200 tolas as reported from important market centres on 9th January 1954 was Rs. 55—6—0 in Tiruppur and Rs. 39—6—0 in Erode and reveal a decrease of 19·1% in Erode and an increase of 7·7% in Tiruppur over last year.

Groundnut—Irrigated—First Report: The area sown with summer-irrigated groundnut crop during the three months January to March 1954 is estimated at 42,700 acres and shows an increase of 14·2% over last year. Compared with the average area of 40,800 acres calculated for the previous five years ending with 1953—1954, it is an increase of 4·7 per cent. The increase in area this year is due mainly to favourable seasonal condition. Sowings of summer irrigated groundnut are in progress in the districts of Chingleput and Ramanathapuram. The condition of the crop is satisfactory. The wholesale price of groundnut (machine-shelled) per standard maund of 82–2/7 lb. of 3,200 tolas as reported from important market centres on 3rd April 1954 compared with the prices published in the corresponding period of last year i, e. on 4th April 1953, reveal a decrease of 16·9 percent in Coimbatore, 15·5 percent in Cuddalore and 14·1 percent in Salem. (Director of Statistics, Madras.

Weather Review — For the month of April, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total for the month	Departure from normal	Total since 1st January	Division	Station	Total for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	0·1	— 0 5	2·9	South	Madurai	2·0	— 0·2	6·8
	Tirurkuppam*	0·0	— 1·2	3·1		Pamban	6·9	+ 5·1	10·4
	Vellore	0·5	— 0·5	3·0		Koilpatti*	2·7	— 0·8	10·7
	Gudiyatham*	0·0	— 1·0	3 4		Palayamcottai	1·2	— 1·3	9·4
East Coast	Palur*	0·5	— 0·3	7·3		Ambasamudram*	1 1	— 2·8	18·2
	Tindivanam*	0·6	— 0·4	8·1	West Coast	Trivandrum	7·1	+ 2·5	16·4
	Cuddalore	1·1	+ 0·1	14·2		Fort Cochin	8·6	+ 3·7	13·7
	Nagapattinam	1·6	+ 0·5	6·5		Kozhikode	6·5	+ 1·6	7·7
	Aduturai*	1 8	+ 0·9	7·0		Pattambi*	4·9	+ 2·2	7·5
	Pattukottai*	5·6	+ 3 8	11·8		Taliparamba*	3·1	..	4·6
Central	Salem	1·8	— 0·1	3·1		Wynaad*	..	..	..
	Coimbatore (A. M. O.)*	2·5	— 0·6	6·8		Nileshwar*	8·8	+ 6·8	10·3
	Coimbatore	3·6	+ 2·0	10·5		Pilicode*	8·1	+ 5 6	9·7
	Tiruchirapalli	3·0	+ 0·6	5·9		Mangalore	4·2	+ 2·3	4 7
						Kankanady*	4·0	+ 2·4	5·1
					Hills	Kodaikanal	5·9	+ 1·1	18·2
						Coonoor*	3·3	— 2·6	23·1
						Ootacamund*	3·7	— 0 4	7·9
						Nanjanad*	2·7	— 2·3	6·5

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

A feeble low pressure wave was moving over the Comorin area on 3-4-1954. This passed away westwards across the Maldives area on 5-4-1954. A shallow low pressure area lay over the Punjab (I) and the adjoining areas on 17-4-1954, which passed away eastwards on the following day. A feeble low pressure area lay off the Konkan coast on 22-4-1954. This concentrated to a depression after two days, with its centre 200 miles south-west of Marmagao, moved in a north-northeasterly direction, weakened to a trough of low pressure on the evening of 25-4-1954 and got filled up on the very next day. A low pressure wave was approaching Tamil Nad on 27-4-1954. This was active over the extreme south Peninsula for a day and weakened. On the last day of the month a low pressure wave was moving westwards across the Andaman Sea into the south-east Bay of Bengal. A series of seven western disturbances passed over the extreme north of the country during this month. Thundershowers were fairly widespread along the West Coast and occurred at a number of places in Tamil Nad during this month. The noteworthy rainfalls and the Zonal rainfall for the month are furnished hereunder:

Date	Name of Place	Rain-fall	Name of Zone	Av. rain-fall for April	Dep. from normal	Remarks
13/4/54	Fort Cochin	2·4″	North	0·15	— 0·80	Below normal
23/4/54	Palghat	3·6″	East Coast	1·87	+ 0·77	Above normal
,,	Pattukottai	4·33″	Central	2·73	+ 0·48	Just above normal
24/4/54	Coimbatore	2·2″	South	2 78	+ 0·00	Normal
,,	Nileshwar	6 57″	West Coast	6·14	+ 3·01	Far above normal
,,	Pilicode	6·65″	Hills	3·90	— 1·05	Below normal
28/4/54	Pamban	3·2″				
29/4/54	Pattambi	3·17″				

Agricultural Meteorology Section
Lawley Road P. O.,
Coimbatore, 11—5—1954

C. B. M. & M. V. J.

Departmental Notifications

Gazetted Service—Postings and Transfers

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Editorial

In a plea for increased food production for a country like India with its varying soil and climatological conditions investigations into the possibilities of double cropping should occupy a premier position. If, with a little additional effort more food could be produced from the same land it would be criminal to have neglected that aspect. The question then arises how far and how best the present arable lands could be put under double cropping and whether all such land that could profitably be brought under this condition has been done so. In a comprehensive survey on an all India basis the I. C. A. R. has published a useful, short review on this subject (Rev. No. 8, 1953). In this review it has been found that India offers a large scope for the practice of double cropping especially in areas enjoying assured irrigation facilities or rainfall. Of the three main cereal crops it is only in wheat and rice lands that the fields are left without any cropping for a long period since these are mostly single crop areas. It is here that suggestion is put forward for cropping the land with suitable soil enriching and also food crops like pulses etc. Though the practice of taking an interim crop is found here and there it has not run into an organized and planned practice. In the millet areas on the other hand the normal practice of mixed cropping keeps the land under cover crops long after the main cereal is off the field. The review runs under several headings: (1) soil conditions, (2) summer catch and cover crops, (3) winter catch crop, (4) double cropping practices, (5) irrigation and summer crop and (6) manuring for double cropping. The review summarises the achievements that have already been obtained and the agricultural practices throughout the length and breadth of India under different agroclimatological conditions. Horsegram is found to be the most favourite winter catch crop in many places. Under padi land conditions as a winter catch crop peas could be tried with advantage as this yields more than bengal gram and does not suffer from wilt and other diseases. The double cropping

systems followed in different parts of India are rice-rice, ragi-ragi, rice-pulses, bajri (cumbu)-bajri, bajri-pluses, bajri-wheat, sorghum (cholam)-pulses, wheat-maize, maize-pulse, or clover, groundnut-wheat or barley, groundnut-ragi and other millets, gingelly-ragi or sorghum and cholam-linseed. Different short duration cultures have been obtained by the State Agricultural Departments to suit these systems of double cropping. Otherwise the practice is not in vogue where long periods of drought intervene between one crop and the next. Where conditions are favourable manuring is found to be essential. Attention to checking of soil erosion is also emphasised. Elsewhere in this issue is published an article on food production and requiremet. In this review it is shown how though Madras State has just attained sufficiency in food at 'adequate level' it is still on marginal side and it is not at 'optimal level'. The food balance is seriously lacking in serveral important ingredients. It is usually over weighted with carbohydrates and very much wanting in others. It is therefore fit that as far as possible these necessary items are also made available in sufficient quantities so as to be available to all. Careful cropping plan to utilize the land between two main crops may lead to solve this problem partially.

Manurial Trials with Ammonium Sulphate on Ryots' Fields in the Madras State

By

M. B. V. NARASINGA RAO *

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Various experiments on rice or paddy at many of the research stations have shown that ammonium sulphate as a manure for paddy has been efficacious and the increases obtained varied from 10 to 30 per cent depending upon the locality and the dosages of ammonium sulphate. Most of the experiments have also shown that the best results with ammonium sulphate are obtained when it is applied some time after planting, i. e. 3 to 4 weeks in the case of short duration varieties and 4 to 6 weeks in the case of medium and long duration rices. With the pressing need for increasing the production of rice, the quickest and surest way would appear to be the use of this manure to the rice crop where irrigation facilities exist. To estimate exactly what percentage of increase of yield ammonium sulphate would give and also to serve as demonstration to other ryots, experiments were started with the application of ammonium sulphate on ryots fields in this State.

Location of Experiments: The experiments were conducted in the several paddy growing taluks in the districts where there are more or less secure irrigation facilities in the official year 1950—'51 as shown below :

District	Taluks and number of experiments (within brackets) in each taluk	Total number of experiments in the district
East Godavary	Peddapuram (9), Pithapuram (7), Rajamundry (6), Amalapuram (8), Ramachandrapuram (6), Kothapeta (7), Rajole (8), Kakinada (6), Tuni (8)	65
West Godavary	Elluru (6), Tadepalligudem (8), Tanuku (8), Bhimavaram (8), Kovvur (5), Narasapur (8)	43
Krishna	Masula (8), Avanigadda (8), Bezwada (5), Gudivada (7), Kaikalur (8)	36
Guntur	Repalle (8)	8
Nellore	Nellore (8), Kovur (8)	16
Madura	Madura (7), Melur (8) Uttamapalayam (3), Periakulam (1)	19
Tanjore	Kumbakonam (8), Pappanasam (7) Nannilam (8), Sirkali (9) Tanjore (7), Kodavasal (3)	42
Pattukottai	Pattukottai (7), Tiruturaipoondi (8)	15
Tiruchirappalli	Lalgudi (8), Tiruchirappalli (8), Kulitalai (8), Karur (4), Musiri (7)	35
Tirunelveli	Tirunelveli (8), Ambasamudram (8) Srivaikuntam, (8), Tiruchendoor (4)	28

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The actual centres of the experiment in each taluk were selected by the District Agricultural Officers concerned. As the object of the experiment was to assess the possible increased yield resulting from the use of ammonium sulphate and not the gross yields, strict randomisation was not adopted.

Treatments: (i) It was thought adequate if two stages of application after planting are considered. This is borne out from a knowledge of a method of nutrition of the paddy plant. For the short duration paddy, 3 weeks and 5 weeks after transplanting were the stages of application and for medium and long duration varieties (Sarva and Samba) the times of application were 4 and 6 weeks after planting.

(ii) Two dosages of ammonium sulphate, i. e. 100 lb. and 150 lb. per acre were included in the experiment. The former is one that is being recommended at present and 150 lb., the higher dosage for such people as could afford it if the increased yield obtained is encouraging. Also two times of application, 3 weeks and 5 weeks for short duration and 4 weeks and 6 weeks for long duration were adopted. The intended trials on the short duration Kuruvai crop could not be laid out as the season for application of the manures was long past by the time the scheme was sanctioned.

Size of the experimental plot: As the soil heterogenety in most of the cultivators' fields is larger than on a research station, 10 cent plots were fixed up for each treatment from which five cents were harvested for yield purposes.

Growth and harvests: The progress of the experiments was now and then studied and special features were noted in the experiment area which might vitiate the results. Such of the plots, which showed excessive variation due to differential rat attack, weediness, want of timely irrigations, etc., were eliminated from the computation of results. All data on the basal dressing of manure, if any, that was applied, the date of planting, etc., and the variety used were gathered. The weights of the produce, both grain and straw from the 5 cents of each treatment were gathered by the Agricultural Demonstrators who were in direct charge of the experiments and these results were analysed by the Paddy Specialist.

Analysis of results: As the original idea of the experiment was to gather the increase of yield that ammonium sulphate would confer under conditions obtaining in the ryots' fields, the yields were recalculated as percentages of the controls, under each time of application and these percentages were statistically analysed. As in most cases two separate fields were taken for each time of application of the manure, these fields were taken as separate series and the control in each of them was taken for that field for calculation of percentages.

It may be mentioned that in some experiments the straw weights were recorded when the straw is totally green resulting in a very high yield. It was therefore found not possible to get at the actual yields of straw. It was found that by the application of ammonium sulphate, straw yield increased from 8 to 30 per cent. In some cases, the weights were of the wet straw. These increased yields in straw were however, not taken into consideration for commenting the economics of the treatments. This extra gain could be set off against the extra labour that would be involved in the spacing of the manure and the additional harvesting charges due to the increased crop production. Only the average percentage of increase of straw in each district is given in statement III.

It was found that the 6 weeks application followed more or less the trend of the results of the 4 weeks application. Hence only the grain yields of the 4 weeks application were statistically analysed taking the villages as replications.

In most of the taluks there were 7 to 8 experiments under each time of application and these were taken as separate replications and the results were analysed statistically for each taluk as one stratum. It was found that the general effect of ammonium sulphate application was significant by the 'Z' test at all taluks except Tirunelveli and Kodavasal. The results of the analysis of grain yields are set out in statement I talukwar. The average increase for the district was weighted where there are different number of plots in the taluks.

The following are brief comments districtwise on the results of the experiment:

East Godavary: Application of 100 lb. of ammonium sulphate (20 lb. of Nitrogen), 4 weeks after planting resulted in increases in the several taluks varying from 6·9 percent in Pitapuram to 21 percent in Tuni. The average increase for the district is 13 percent over control. By an application of 150 lb. of ammonium sulphate (to give about 30 lb. N) there was an increase of 18 percent over control. Though it may not be very correct to estimate from these small number of trials the actual increased production, we may at a safe estimate reckon the increase at 300 lb. of grain from 100 lb. ammonium sulphate application and 400 lb. for 150 lb. application. It may be pointed out that the control plots yield about 2500 lb. per acre including the tank-fed areas of Tuni and Pithapuram. Thus, though the increased percentage is about 15 and 18 by the applications of 100 lb. and 150 lb. of ammonium sulphate, the increased production is fairly high. Most of the ryots in this district manure their lands either with cattle manure or some leaf. It may be mentioned that application of ammonium sulphate 6 weeks after planting has secured slightly less increases and hence for this district application of ammonium sulphate 30 days after planting is the best stage.

West Godavary: In most of the villages, the treatments included application of 80 to 100 lb. of ammonium sulphate and hence they were analysed with no ammonium sulphate and ammonium sulphate as a paired set. The increase of grain by application of ammonium sulphate varied from 12 to 35 percent and the average yield increases in the district was found to be 23·7 percent with a net profit of Rs. 54/- per acre. Most of the areas here are also well cultivated. The application of the artificial manures gave good response even in saline areas. It was also more efficacious in sandy and loamy types than on the stiff black clay which usually support a good paddy crop.

Krishna: In this district comparing the 150 lb. and 100 lb. applications it was found that ammonium sulphate at 150 lb. gave slightly higher yields within the critical difference. Application of 100 lb. of ammonium sulphate gave 10 to 32 percent increased yields over 'no ammonium sulphate' control, the average for the district working out to 20·4 percent, equivalent to 460 lb. of grain with a profit of Rs. 41/- per acre. It was found that application of manure four weeks after planting was better than application at six weeks after planting.

Guntur: The experiments were laid out only in one taluk, Repalle, as in the other taluk, Tenali, planting was done much ahead and the season for application of ammonium sulphate was over by the time the scheme could start. It was found in this taluk that 150 lb. ammonium sulphate had given a significantly higher yield than 100 lb. application. Application of 150 lb. sulphate gave 25 percent increase in yield equivalent to 600 lb. while 100 lb. gave 15 percent increase corresponding to 350 lb. grain. The soils in this taluk are loamy to sandy and the fertility is not as high as in other parts of the Krishna delta. Thus for this taluk, 150 lb. dosage of ammonium sulphate may be recommended for application of the sulphate is better done at four weeks after planting than otherwise.

Nellore: In the two delta tuluks, Kovur and Nellore, the experiments were conducted as in other East Coast districts. The application of ammonium sulphate 4 weeks after planting was somewhat superior to '6 weeks after planting' though the difference is only 4 percent. Application of 150 lb. gave increases ranging from 0 to 80 percent and 100 lb. application from 4 to 71 percent (the highest percentage being in the poorer types of soil near the coast). The average increase for 150 lb. application was 21 percent equivalent to 420 lb. of grain while 100 lb. application gave 14 percent increase, equivalent to 270 lb. of grain. In 8 of the 16 villages 150 lb. application gave higher yield than 100 lb. application. The profits were Rs. 17/- for 100 lb. application and Rs. 28/- for 150 lb. application.

Southern districts: Tanjore: The trials were conducted in seven taluks. Due to the very high bunds in the delta it was generally reported

that there was some amount of rat damage in the several experiments and this fact does naturally vitiate the results considerably. It is difficult under the ryots' conditions to estimate such loss and allow for it in the computation. It was also reported that some fields suffered for want of water at the last stages and the yields from them are therefore generally lower than these with fuller supplies. It was also seen that in many of the plots the ryots did not apply any basal dressing of organic matter. This is another feature which sets a limit to the action of ammonium sulphate. Even with the limitations, however, it was found that applications of ammonium sulphate at 100 lb. at 4 weeks after planting secured an increase varying from 7 per cent in Kodavasal (200 lb.) to 26 per cent in Tanjore (450 lb.) with an average increase of 13·5 per cent (270 lb.) over no ammonium sulphate treatment. With 150 lb. application the increases varied from 13 per cent to 36 per cent (620 lb.) over no ammonium sulphate with an average of 23 per cent (460 lb.). Application of ammonium sulphate six weeks after planting did not show much advantage and as a matter of fact 150 lb., four weeks after planting was found to be somewhat better. Valuing the grain and manure at the present rates it was found that 100 lb. ammonium sulphate application four weeks after planting gave Rs. 17/- profit while 150 lb. application secured Rs. 33/-.

Pattukkottai: The new delta in this tract included a large area which has been recently reclaimed. The cultivation here is generally poor. As can be seen from statement I the acre yield of the control plot (where no ammonium sulphate is applied) is only 1630 lb. It was found that 100 lb. of ammonium sulphate applied four weeks after planting gave 12·9 per cent increase (equivalent to 210 lb.) and 150 lb. gave 16·6 per cent increase equivalent to 270 lb.) of grain working out to a profit of Rs. 10/- and Rs. 9/- for the two applications respectively. Ammonium sulphate applied six weeks after planting gave less yields than the 'four weeks application'.

Tiruchirapalli: This is one of the rich areas of the State and the average acre yield of the control itself is as high as 3010 lb. Usually a crop of green manure is raised for the samba areas. One hundred pounds of ammonium sulphate applied four weeks after planting gave an increase of 10·9 per cent (equal to 330 lb.) with a net gain of about Rs. 25/- while 150 lb. application gave a 15 per cent (equal to 450 lb.) with a net gain of Rs. 32/- per acre.

It was found in this district ammonium sulphate applied six weeks after planting gave higher percentage of increase than the application four weeks after planting. 100 lb. of ammonium sulphate when applied six weeks after planting secured 21·3 per cent increase (630 lb.) with a

net gain of about Rs. 32/-. There was no difference in yield between 100 lb. and 150 lb. when applied six weeks after planting.

Madura: The rice area of this district especially that under the Periyar Project is one of the most fertile zones of the State and high yields of rice are recorded. The ryots are usually very painstaking and try to manure the lands with some manure or other. The control plot in this district gave an average acre yield of 2610 lb. It was found that the application of ammonium sulphate four weeks after planting was superior to that applied six weeks after planting. Application of 100 lb. of ammonium sulphate four weeks after planting secured an increased yield of 22·9 per cent over control (equivalent to 600 lb. per acre) with a net gain of Rs. 59/- per acre while, the application of 150 lb. of ammonium sulphate secured a substantial increase of 1100 lb. per acre, i. e. 42 per cent over control, the net gain working out to Rs. 113/-. This might appear somewhat high but considering the soils which are well drained, with good irrigation facilities, the yields might be taken to be normal for the tract.

Tirunelveli: The Tamraparni basin consisting of about half a lakh of acres of double-croped wet land is one of the most fertile of rice zones usually met with. The kar crops give high average yields of 3500–4000 lb. per acre but the second crop harvest is usually not of this magnitude. It was reported that due to the failure of the North-east monsoon during 1950–'51 there was certain amount of drought in the second crop and consequently the yields were affected to some extent. The control (no sulphate) plots gave an average acre yield of 2520 lb. Application of ammonium sulphate of 100 lb. four weeks after planting gave increases varying from 5 to 20 per cent with an average of 12·3 per cent (equivalent to 310 lb.) working out to a net profit of Rs. 22/-. There were no differences in the efficacy of 100 lb. or 150 lb. of ammonium sulphate, the high dose giving a less economic return. It was also found in this district that the applicaiton of ammonium sulphate at six weeks after planting was better than four weeks; the 100 lb. application at six weeks gave a net return of Rs. 37/- and 150 lb. a net return of Rs. 25/-.

Conclusion: A perusal of the statement shows that in general, ammonium sulphate applied four weeks after planting at a dosage of 100 lb. is efficacious securing at least an increased yield of 259 lb. of grain per acre. In certain districts 100 lb. was quite optimum and efficacious as it gave as good and sometimes higher returns than 150 lb. As a general practice, 100 lb. of ammonium sulphate to be applied four weeks after planting over some basal dressing of organic matter, if it could be secured, may safely be recommended. If funds permit, 150 lb. of sulphate can also be applied but this may depend upon the inherent fertility of the field, the nature of soil, etc. This higher dosage is more effictive on lighter soils than on heavier types.

STATEMENT No. I.

Results of application of Ammonium sulphate on ryots' field four weeks after planting

District	Acre yield of control plot	100 lb. Ammonium sulphate			150 lb. Ammonium sulphate		
		Increase		Profit for acre	Increase		Profit for acre
		%	Grain in lb.		%	Grain in lb.	
				Rs. A. P.			Rs. A. P.
East Godavari ..	2520	13·1	330	25 1 0	17·9	450	31 9 0
West Godavari ..	2350	23·7	560	53 9 0	..	..	..
Krishna ..	2260	20·4	460	41 1 0	24·8	560	45 4 0
Guntur ..	2380	14·7	350	27 7 0	25·2	600	50 4 0
Nellore ..	2010	13·4	270	17 7 0	20·9	420	27 12 0
Tanjore ..	2000	13·5	270	17 7 0	23·0	460	32 12 0
Pattukottai ..	1630	12·9	210	9 13 0	16·6	270	9 0 0
Tiruchi ..	3010	10·9	330	24 13 0	15·0	450	31 8 0
Madura ..	2610	22·9	600	58 9 0	42·1	1100	112 12 0
Tirunelveli ..	2520	12·3	310	22 5 0	9·9	250	6 8 0

(1) Grain valued at 0—2—0 per lb. (2) Cost of ammonium sulphate at Rs. 16—7—0 per 100 lb.; Rs. 24—12—0 for 150 lb. (3) Value of straw not taken into consideration, for profit. (4) Includes super application also in some taluks.

STATEMENT No. II.

Results of application of Ammonium sulphate six weeks after planting

District	Yield of control	100 lb. Ammonium sulphate			150 lb. Ammonium sulphate		
		Increase		Net profit nearest to rupee	Increase		Net profit nearest to rupee
		Grain yield lb.	%		Grain yield lb.	%	
East Godavari ..	2240	280	12·5	19	340	15·2	18
Krishna ..	2220	310	14·0	22	430	19·4	29
Guntur ..	2220	250	12·6	15	540	24·3	43
Nellore ..	2140	240	11·2	14	360	16·8	20
Tanjore ..	1990	290	14·6	20	410	20·6	27
Pattukottai ..	1710	100	5·8	4	200	11·7	..
Tiruchi ..	2960	630	21·3	62	600	20·3	50
Madura ..	2640	430	16·3	37	690	26·2	65
Tirunelveli ..	2420	430	17·8	37	400	16·5	25

STATEMENT No. III.

Yield of straw in the several districts Ammonium sulphate applied four weeks after planting

District	Control	Ammonium sulphate	
		100 lb.	150 lb.
West Godavari ..		Not available	
Krishna ..		Not available	
Guntur ..	100	113	126·6
Nellore ..	100	116	124·0
Pattukottai ..	100	115·8	128·3
Tanjore ..	100	111·7	118·1
Tiruchirappalli ..	100	108·2	116·5
Madura ..	100	115·7	135·5
Tirunelveli ..	100	107·5	114·5

Drying of Sweet Potatoes and Preparation of Flour, Biscuits and Cakes

By

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Introduction: The sweet potato, (*Ipomoea batatas*), belonging to the family of Convolvulaceae, is a crop that has established itself very well in our country. In view of the increased interest in this crop as an article of diet, it is proposed in this paper to give simple directions in drying for storage and for the manufacture of flour products, such as biscuits, bread and cake.

The sweet potato is a plant of tropical America, its original home probably being the West Indies and Central America. Its cultivation is simple as it comes up in almost every kind of soil, though it makes its best growth on sandy or well drained soils. It is fairly well known that sweet potato forms an exceedingly nutritive food. It can be and is eaten raw, fried, roasted or boiled. But its usefulness when the tubers are sliced and dried in the sun and ground into flour and baked into bread, biscuit and cake is not so widely known. The sun dried chips converted into flour can be used in a variety of ways as an article of food. The sweet potato can also be preserved for a long time by a simple process of boiling the tubers, pressing the cooked tubers into cakes and drying in the sun.

Preparation of Sun Dried Chips: The tubers are washed well prior to slicing and scraped with a knife to remove the rind. The rind-free tubers are then sliced into chips of not more than quarter of an inch in thickness, spread over a cloth or on a clean cement floor and dried in the sun. Freshly cut slices are white in colour which change to cream yellow after two hours of drying. After about eight hours of drying, the slices are generally of dull white colour and crumble easily on pressing. In about 10 to 12 hours the drying is complete.

Flour: The sun dried chips are converted into flour by pounding in an iron or stone mortar and sieving. The flour prepared thus is creamy white in colour.

Chips: The sun-dried chips will be from $\frac{1}{3}$ to $\frac{1}{4}$ the weight of raw tubers taken for drying. The moisture content of the sundried chips will vary from 5 to 10 per cent depending upon the thickness of the slices. Sweet potato chips were prepared by the method mentioned above in a number of places and the samples were analysed in the laboratory for moisture, cooking quality and palatability. Cooking tests

were carried out by putting the chips in twice the volume of water and boiling. All the samples got cooked between 30 and 45 minutes. The results of cooking tests are given in the statement appended.

It may be seen that the taste of the cooked product was generally insipid. Hence, it is possible to use the dried chips for preparing the usual dishes after reconstituting them with water prior to cooking. They will be similar to any dehydrated vegetable in flavour and taste. The composition of sweet potato chips and flour is given below:

TABLE I
Analysis of Sweet Potato
Chips and Flour (different samples)

Heads of Analysis	Desiccated chips %	Flour %
Moisture ..	10·46	11·33
Ether extractives ..	1·18	0·62
Crude fibre ..	1·91	2·21
Ash ..	3·04	1·84
Protein ..	4·50	1·94
Starch ..	46·22	50·03
Dextrose ..	18·55	10·75
Sucrose ..	10·93	19·61
Undetermined ..	3·21	1·67

(From Farmers' Bulletin No. 129. U. S. D. of Agri.)

Preparation of Bread, Biscuit and Cake with Sweet Potato Flour: Sweet potato flour can be used with maida flour for the manufacture of bread, biscuit and cake. For bread, equal parts of sweet potato flour may be used with maida. The bread so made is naturally a bit "heavy" and does not rise satisfactorily but when made into toast is palatable.

Biscuits can be prepared with sweet patato flour using upto 50 per cent of the total quantity of flour used without any detriment to quality. A recipe for the preparation is given below. For comparison, the amount of ingredients used for making ordinary biscuits is also given along with.

TABLE II

Ingredients Quantity—3 pounds of flour	Sweet potato biscuit	Ordinary biscuit
Sweet potato flour ..	24 oz.	..
Maida flour ..	24 ,,	48 oz.
Sugar ..	20 ,,	24 ,,
Butter ..	12 ,,	8 ,,
Ghee ..	4½ ,,	2¼ ,,
Baking powder ..	2 ,,	1 ,,
Flavouring etc. ..	Q. S.	Q. S.

From the above recipe it will be seen that sweet potato flour requires less sugar, but more of fat and baking powder. The biscuits have to be baked for a little while longer than for the ordinary biscuits. Slight darkening round the edges is likely to occur but it does not affect the quality of the product in any way. The flour requires to be kneaded for a longer time than the maida flour. Sweet potato biscuits prepared with about 50 per cent of the flour analyse the following: Moisture—0·79%; Protein—5·31%; Ether extractives—12·27%; Acid value—4·5 mgms./gram of fat.

These biscuits keep well and crisp for a long time. Biscuits prepared in a local bakery according to the above recipe and kept in

glass jars for ten months did not show any deterioration in taste or smell. They were found good even after one year. After storage for ten months the biscuits analysed as: Moisture 4·34%; Ether extractives 11·77%; Acid value 5·58% (mgm. KOH/gm. fat).

Preparation of Cakes: Good quality cakes can be prepared with sweet potato flour. The recipe given below may serve as a guide.

		Spice Cake	*Plain Cake*
Sweet potato flour		80 gm.	80 gm.
Maida flour		60 ,,	60 ,,
Sugar		140 ,,	140 ,,
Eggs		4 ,,	4 ,,
Butter		150 ,,	150 ,,
Milk		120 ,,	120 ,,
Baking power		15 ,,	15 ,,
Salt		One pinch	One pinch
Spices	Cinamon, Nutmeg, Cloves, Cardamom, Mace, Ginger	½ teaspoon	

When made each cake will weigh about a pound and a quarter.

Other ways of preserving sweet potatoes: 1. *Boiling and pressing:* The tubers are washed well to remove the adhering soil and placed in cold water and raised to a boil and kept boiling for about one hour cut into slices and dried. They can also be pressed into cake and dried in the sun for a day or two. The sun dried slices and cakes are brick hard and can be stored for over two years. When required for use they are soaked in water for a few hours, washed and cooked in the usual way. Some people claim that its taste is even better than the fresh ones. Nearly 50 per cent of the original weight of tubers are obtained by this method.

2. *Cooking and pressing through a vermicelli press:* The tubers are cooked and mashed with a little salt, pressed with a vermicelli press and dried in the sun. These can be stored in glass jars or tins for a long time. Wheat flour upto 25% can be included with the mashed tubers and given a short cooking before pressing. This product may be used in a variety of ways if one has the taste for it.

3. *Sweet potato starch and other product:* The sweet potato flour can be used for the preparation of starch, syrup and malt extracts and other useful and edible products.

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APPENDIX

No.	Samples from	Description of slices	Cooking quality, taste etc.	Moisture content of chips Per cent
1	Coimbatore Paddy Station	Brownish white thin slices rind intact	Insipid darkened on cooking	5·74
2	Kasargod	do.	Insipid	8·21
3	Palur	White thin slices	Inspid, darkened slightly	10·28
4	Ambasamudram	Brownish white rind intact	Inspid	9·10
5	Taliparamba	do.	do.	7·36
6	Gudiyattam	Grey white	No taste	6 04
7	Central Farm, Coimbatore	Thin white slices	Taste not bad	5·84
8	Pilicode	Brownish white	Insipid, darkened	7·95
9	Aduthurai	White big slices	Sweet, darkened	8·65
10	Tindivanam	White thin chips	Good—No colouration	5·77
11	Nileshwar	Light brown thin slices	Inspid—darkened	7·64
12	Pattukottai	White small thick slices	Insipid, turned brown	7·81
13	Koilpatti	Brownish thin slices	Insipid, darkened completely	9·05
14	Pattambi	Dull white big slices	Not palatable	7·14
15	Kallar	White thick slices	Insipid, darkened	8·10

Transmethylation and Methyl Synthesis

By

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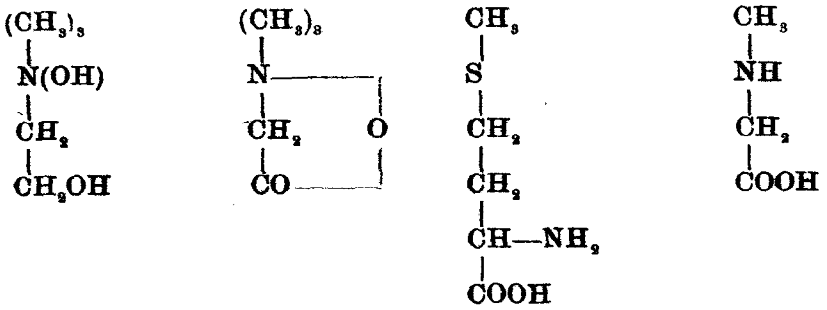
Introduction : Converging lines of research by nutritonists, chemists and clinicians lead to something entirely new in dietary requirements. Nutritional requirement had usually been in terms of whole complex compounds like the fats, carbohydrates or vitamins or in terms of simple elements like calcium, phosphorus etc. But for the first time and for probably the only unique instance of dietary requirement a group like the methyl group emerges out as an entity in Nutrition. Its discovery came about in the study of the diverse metabolic reactions of apparently totally unrelated compounds like casein, cysteine, methionine, choline, folic acid and recently Vitamin B_{12}.

Research on the amino acids on the one side, with the search for lipotropic substances on the other and lately the vitamin studies soon

focussed particular attention to this group as of such great importance in dietary requirements that as a result of numerous further studies since done, it has come to stay as an essential nutrient which has to be supplied to the animal for growth and metabolic function.

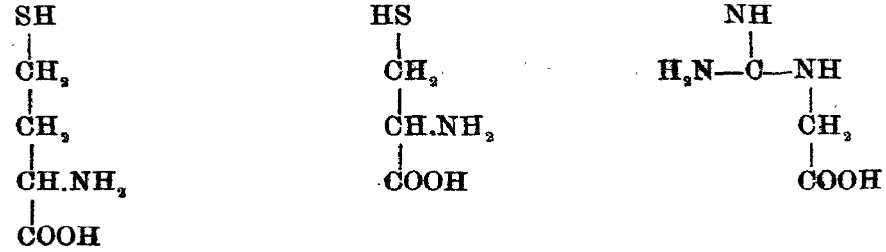
Source of Methyl Groups: This biologically important group of compound is found in a number of compounds which have been called methyl donors:

Choline — Betaine — Methionine — Sarcosine



These compounds have in common what is now known as "biologically labile methyl groups." By this is meant, that all methyl groups as a class are not all biologically useful unless they are found in specific compounds which allows the methyl group to be labile or transferable from them to what are now known as "methyl acceptors." Under the class of methyl acceptors or receptors the following could be mentioned:

Homocystine — Cysteine — Guanido acetic acid



These could take on methyl groups to form other biologically important compounds and this process of transferring methyl groups is known as transmethylation. Thus having defined the main terms involved in this study and the compounds that play a role in the nutrition of the methyl group a chronological review of the works that lead to the discovery of the group would make the picture complete.

Transmethylation: The phenomenon of transfer of methyl groups in biological systems came to be identified as a result of work done in almost entirely different fields as mentioned at the outset. These could be classified and discussed under: 1. Amino acid research; 2. Search for lipotropic and anti-lipotropic substances; 3. Vitamin research.

Amino Acid Research: Jackson and Block (17) working on diets low in casein for rats, found improved growth with the addition of methionine. Meanwhile to check some contrary findings of the time on fatty livers in relation to low casein and high casein diets, with and without the amino acid cystine, Tucker and Eckstein (28) set up an experiment to find the effect of added cystine in a low protein high fat diet. They found that cystine caused fatty livers when added to a high fat ration and that if the other sulfur containing amino acid viz., methionine was supplied this condition was prevented. Subsequently Rose and his associates (24) using purified amino acids showed that the addition of cystine alone to a diet deficient in both cystine and methionine was practically without any effect while on the other hand the incorporation of methionine in such a diet permitted rapid growth. Here was a poser which needed clarification, for, if the body needed sulfur containing amino acids to replenish the high content of sulfur in keratin proteins such as wool, hair, nails and hooves, in hormones such as insulin, etc., why should there be a difference in the growth response of methione and cystine, which were both sulfur containing amino acids?

A clue in the metabolism of the two sulfur containing amino acids was brought about by the work of Tarver and Schmidt, who fed methioine with labelled sulfur and isolated cystine with the labelled sulfur (29), thus showing the conversion of methionine to cystine. So, if the methionine could supplant the function of cystine, by synthesising it in *vivo*, it soon became evident that sulfur was not the key note for the dietary efficiency of methionine. It should therefore have something which cystine does not contain.

It was known at this time that the phospho-creatine is hydrolysed and re-synthesized during muscle action. Du Vigneaud et al (2, 10) showed by means of isotopic elements in D. L. Methionine that this amino acid contributes its methyl group for the conversion of guanido acetic acid to creatine. Thus, it became evident by 1941, that the methyl group was the important factor in the varied reactions obtained with the sulfur containing amino acids.

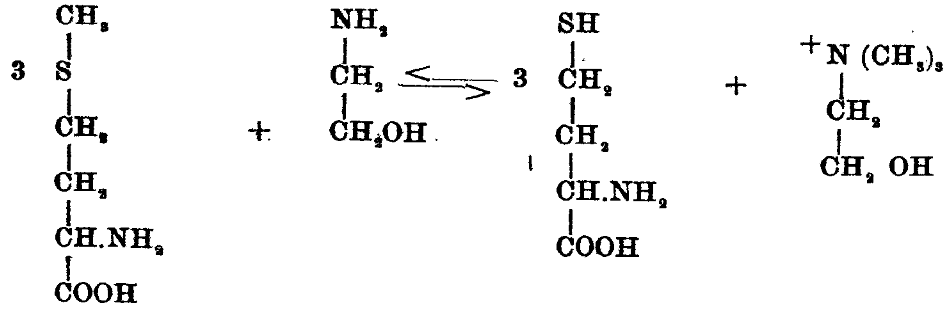
Search for Lipotropic and Anti-Lipotropic Substances: Side by side with the knowledge accumulating on amino acids, facts began to accumulate on substances which cause certain clinical symptoms in the animal system. These symptoms were invariably found to be (i) severe degeneration of liver cells concommittant with hemmorhage and intestinal inflamation (ii) degeneration occurring in the convoluted tubules in the kidneys (iii) deposition of fat in the liver.

Best, Hershey, and Huntsman (1, 2) had observed as early as 1932 that a deficiency of choline, betaine or methionine in the diet of young rats or dogs causes the deposition of fat in the liver. Du Vigneaud

(8) proposed homocystine as a possible intermediate in the conversion of methionine to cystine. This was found to cause fatty livers in the absence of methionine or choline, i. e., it was anti-lipotropic. Glynn, Hinswoth, and Neuberger (14) kept rats on a diet deficient in methionine and cystine and observed the development of massive hepatic necrosis which was prevented by methionine. Best and his co-workers (2) had reported that lecithin in the egg yolk was capable of preventing fatty livers and that the active lipotropic agent in lecithin is choline. Thus it became established that methionine and choline were lipotropic while homocystine and cystine were anti-lipotropic. Sulphur was not the incriminating factor in fatty livers for the sulphur containing compounds were ranged on either side. The answer to this enigma came from Du Vigneaud in 1942 and may be best put in his own words :

"This striking difference in lipotropic activity between homocystine and methionine was not inconsistent with the idea that the methyl group of methionine played an important role in the synthesis of choline by the body. Thus what was otherwise a perplexing similarity of action on the part of two apparently totally unrelated compounds such as methionine and choline, was, according to this hypothesis of transmethylation, readily understandable. The possession of a labile methyl group as the characteristic which choline and methionine had in common was not suspected as the explanation of this lipotropic activity until homocystine-methionine studies indicated a metabolic inter-relationship between choline and methionine" (11).

Thus transmethylation—the transfer of a methyl group from one compound to another—seemed to answer the apparent enigma. The scheme of transmethylation may then be pictured as follows :



Transmethylation has now been proved beyond doubt by a number of subsequent works, but the subject of methyl groups did not however become a closed chapter. It soon became interlaced with the subsequent studies of the B-Vitamins.

B-Vitamins and Methyl Groups : **Niacin :** Handler and Dann (16) found that 1% nicotinic acid or its amide caused toxic manifestations.

with concomittant loss of weight, which was counteracted by methionine but not by cystine or homocystine. Apparently nicotinic acid created a labile methyl group deficiency which was corrected by methyl donors.

Folic Acid and Vitamin B_{12}: Toennies, Bennett and Medes (30, 31) repeatedly came across conflicting results with rats in that they were able to obtain growth with methyl free homocystine containing diets. Analysis of the body showed an actual increase of methionine during the experimental period while the diet was free of labile methyl groups.

When a sulfasuxidine, along with eight B vitamins was given, the growth ceased (3). It seemed therefore that the sulfasuxidine had inhibited the formation of a methylation factor distinct from the essential growth vitamins. This lead them to conclude that "there may be vitamin factors of either dietary or intestinal origin, the presence of which may enable the animal to compensate for the absence of dietary methyl donors by biosynthetic means of its own or intestinal bacteria." When liver extract was added to such a methyl free homocystine diet in place of the B vitamins, growth was obtained

Patton and co-workers (22) noted in chicks that the growth promoting effects of methionine as a supplement to a corn soybean diet was no longer observed when "2% sardine meal was added to basal diet. Cunha et al (6) working with pigs found that Vitamin B_{12} and APF were similar from the standpoint that methionine did not help in growth when fed in addition to either of them and that methionine improved growth of pigs only in the absence of an APF supplement. Shive (27) found that methionine and vitamin B_{12} could function interchangeably in enabling growth of *Escherchia coli* to take place on a medium containing sulfanilamide. In rats, Schaeffer and coworkers (26) demonstrated the protection afforded by B_{12} against kidney damage produced by a diet low in choline and methionine. Drill (7) showed the lipotropic effect of B_{12} in rats. Gills and Norris (15) find that the inclusion of a source of APF in their basal diet obviated the need for supplementary methylating compounds for chicks. All these studies seemed to indicate a definite relationship between methylating compounds and B_{12}.

Next came the observations on folic acid by Bennett (4) which partly cleared up the exact relationship. She reported that folic acid in the absence of sulfasuxidine promoted growth on a methyl-donor-free-diet, but there were some cases of growth in the presence of sulfasuxidine also. This indication of the rat's ability to utilise homocystine even though the intestinal folic acid synthesis had been checked by the sulfa drug was interpreted by her to mean that folic acid was not the only factor involved and that some other factor probably vitamin B_{12}, by being stored in varying degrees in the pre-experimental period might probably

be involved. In a subsequent experiment (5) she reported that B_{12} plus folic acid gave an effect similar to that obtained earlier with crude liver extracts with rat's on the methyl-free-homocystine diet.

Patrick (23) found in chicks that methionine and B_{12} gave the same growth response and when both were added the growth response was no greater than either. Jukes, Stokstad and Broquist (18) report B_{12} as involved in both the methionine and choline requirement of chicks.

So, from all these it was evident that vitamin B_{12} was somehow concerned in the synthesis of methyl groups in the animal system. Whether these were formed in the enzyme system of the tissues or effected through the intestinal bacteria was the next aspect to be investigated. Oginsky (21) using rat liver homogenate found that liver from B_{12} deficient rats exhibit a lower ability to form methionine from homocystine and either choline or betaine, as compared with those from animals dosed with Vitamin B_{12}. In vitro activation of the methionine forming system by addition of solutions of crystalline Vitamin B_{12} (Merck), proved unsuccessful. Hence though B_{12} is concerned in vivo synthesis of methyl groups, its mechanism is still not clear. That the biological synthesis of methyl groups in the presence of B_{12} was only by tissues was shown by the use of germ free animals (12).

Vitamin B_{12} and folic acid therefore seems to bear some relationship to labile methyl metabolism and its synthesis in the animal system.

The source of the carbon from which the synthesised methyl group is obtained has been studied in recent times and though the reports are conflicting, it may be said to be probably derived from glycine or serine.

Sakami and associates (25) report the incorporation of the methyl group of labelled acetone and of formate into the methionine and choline methyl groups. While Jonsson and Mesher (19) fed serine labelled with C^{14} in beta position and isolated choline with radio activity in the methyl group and believes there is reason to state that pteroylglutamic acid and Vitamin B_{12} may be involved in these transformations.

Weissbach et al (32) reports that L-serine is not only a source of ethanol amine portion of the choline but also of its methyl carbon atoms.

Elwyn and Sprinson (13) showed the extensive synthesis of methyl group of thymine in the adult rat. The activity of the methyl carbon atom of thymine following the administration of beta labelled serine accounted for 90% of the total activity of the molecule and was about 2·5 times that of the methyl groups of choline. The authors suggest that the reported role of folic acid and Vitamin B_{12} in the synthesis of methyl groups and the common origin of the methyl groups of choline

and thymine and the 2 and 8 positions of uric acid offers an explanation for the known replaceability of folic acid or Vitamin B_{12} by thymine in certain deficient micro-organisms.

These results undoubtly show that synthesis of the methyl group is possible in the animal system and need not be an essential supplement, provided fairly high levels of Vitamin B_{12} and folic acid are furnished.

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Food Production and Requirements of the Madras State

Communicated by

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The food problem of a State is essentially one of feeding its population, firstly, to satisfy the primary needs of hunger and secondly, to ensure the supply of the various food constituents in adequate amounts to prevent demonstrable deficiency diseases. To attain these two important objects, reliance is usually placed on internal food production; whenever gaps or deficits are detected, they are attempted to be overcome by suitable imports, depending on the availability and willingness of food surplus States to export, and the financial resources of the importing States. There is, of late, a growing tendency, almost universal, to gear up agricultural production to self-sufficiency levels and to minimize as far as possible, if not to completely eliminate, food imports. The levels at which self-sufficiency may be attained cannot be stated in absolute or well-defined terms. Food needs for self-sufficiency at 'optimum levels', the ideal to be kept in view in formulating food production plans, would obviously differ from those needed for self-sufficiency at 'adequate levels'. It is well to remember in this connection that chronically under-fed people have impaired, and sometimes depraved, appetite and are almost insensible to their lack of food. But, they do not function normally, let alone function at their best; every attempt should be made to provide them with sufficient and wholesome food. In these endeavours, it is essential to know the quantum of food production in the State and to equate it in relation to the nutritive requirements of her population.

Figures of food production in a State can be ascertained by one of the following means: (1) ascertaining the average food consumption of an individual, determined through detailed diet surveys carried out on a large segment of the population representing the various cross-sections, and multiplying it by the total number of people in the State; (2) by pooling the various production figures put out by government agricultural departments, and (3) by a knowledge of the extent of cultivated land under the various food crops and of their normal yields. Of these three methods, the first is very laborious and time-consuming and yet not capable of yielding even a reasonably reliable estimate. The second process may be fairly trustworthy and may give satisfactory data in

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* The "Madras State" here refers to the composite State as it existed before the 1st October 1953, when the partition of the Andhra State and cession of a major portion of the Bellary district to the Mysore State took place.

normal times. But in periods of relative shortage, with consequential governmental controls and procurements, there is likely to be a tendency on the part of the producers to underestimate and deliberately suppress their production figures for major items of foodstuffs like cereals and pulses, while production figures for less major ones like vegetables, fruits, etc., may not, to a large extent, enter into the picture at all. Such under-estimates and suppression of figures are not expected to be present or, if present, it will be minimal—in the data for the extent of cultivated land under the various food crops but figures for yield will suffer from the same handicap. Yields are usually given not in absolute figures but as a range between two figures, the average of which may be expected to reflect the yield in a large area in the State. Instead of employing the mean of this range, the adoption of the lower figures of yield worked out by the official agricultural experts would help in arriving at a safe and conservative estimate. This method may often err, but it will be comforting to know that it errs only on the safer side. Hence, it was adopted in the present estimate in preference to the other two methods outlined above. It was also felt that this method will introduce fallacies to a minimum extent.

The recent publication of the revised and enlarged edition of Wood's "Agricultural Facts and Figures" (1952) by the Madras Government prompted the present attempt to assess the food situation in the composite State of Madras. Such appraisal is desirable in view of the statements often made, sometimes alarming, about the food situation in the Madras State. In the present computation, it should be distinctly understood that the figures relate to a normal year without the visitations of such abnormalities as floods, drought, etc. Even so, the figures are to be considered only as approximations likely to be of help in shaping future agricultural policies. An assumption has been made that imports and exports of food, into and from the State, are considered negligible and may neutralize one another, and hence, do not seriously vitiate the calculations. This assumption may not be justifiable in the case of pulses, for which there is a fairly large scale import into the State. Even so, the overall intake of food will not be seriously altered. Further, these assumptions would appear extraneous to a study confined to the actual food production in the State.

The acreage under various food crops and figures for yields employed in the present computation of agricultural production are given in Table I. Assuming that the available food were equitably distributed among the entire population, the food available per 'consumption unit' per day was calculated and is also shown in Table I. In this calculation it was felt that data per 'consumption unit' would be more useful than the corresponding figures per head of the population. In the conversion of population figures into 'consumption units', various ratios have been

suggested based on the age structure of population revealed by census data and the respective calorie coefficients of the age-structure. Mitra (1952) has worked out that a population of 10,000 would be equivalent to 7,310·5 'consumption units' or roughly 0·73 'consumption unit' per head of population. This ratio has been held by many to be too low; a critical assessment by others has shown that a figure of 0·80 per head of population would be a more reasonable one and hence this was adopted in the present calculations. The population of the Madras State is about 54 millions. The total 'consumption units' in the State would then work out on this basis to 43·2 millions.

It is also relevant to mention the following additional details which have a bearing on the construction of Table I.

Cereals: Though about a dozen cereals are stated to be grown and consumed in the Madras State, only the more important nine of them have been included in the table. Figures for acreage for the common millet (*Panicum miliaceum*), Sanwa millet (*Echinochloa frumentacea*) and Korali (*Setaria glauca*) are not available. Further their production and consumption may be expected to be relatively small and are hence not included. Their non-inclusion will be in accordance with the general aim of maintaining the estimate of production on a conservative basis.

Pulses: Only the major five have been included, omitting the relatively minor ones like field bean (*Dolichos lablab*), Cowpea (*Vigna ungiuculata*), soya beans (*Glycine max*), Pillipesara (*Phaseolus trilobus*), *Phaseolus sublobatus* and dew gram (*Phaseolus aconitifolius*).

Nuts and Oilseeds: The three major edible oilseeds, groundnut (*Arachis hypogea*), gingelly (*Sesamum indicum*) and coconut (*Cocos nucifera*) are only taken into consideration. It is presumed that the production and consumption of other nuts and oilseeds are not substantial enough to make any tangible contribution to food intake.

Condiments and spices: Though a large number of condiments and spices are produced and consumed in the state, account has been taken of only three of them chillies, onions and turmeric, which are produced in fair quantities. Though figures for the extent of cultivation in the State and yields are available for an additonal dozen or so condiments and spices, they are not included in the construction of the table as being inconsequential.

Fruits: Quite a large variety is grown and consumed, but for most of them, data are scanty. Some are too expensive to merit consideration in population-production data. Some are prolific yielders like the Jack (*Artocarpus integra*), pine apple, citrus fruits, guava, papaya, etc., and being not so expensive may contribute in a small measure to the total

food intake. But, the absence of data on their production and consumption in the State precludes their inclusion in the present calculations. Only the two major fruits, cheap and relatively abundant, mango and banana (which includes the plantain) are taken into account. The non-inclusion of others, particularly the citrus fruits, will help maintaining a conservative estimate of fruit production and consumption.

Vegetables: Though a variety of vegetables are grown and consumed, authentic data are lacking for most of them. Being a tropical country with luxuriant vegetation, it is to be expected that a large number of them would be extensively grown and consumed. But diet surveys do not reveal a liberal consumption of vegetables by the bulk of the population. No record is available of the vegetables grown in many kitchen gardens and consumed both in the rural and urban areas. Any guess about their production and consumption would be so wide off the mark that it would be safe to omit them in the calculations of food intake. Data relating to two of the root vegetables, potato and tapioca, are, however, available and are included in the table.

Milk: Various estimate and 'guestimates' of milk production and consumption in the State are available. Most of them are in the neighbourhood of 3·5 oz. per head per day, all of which is not consumed as fluid milk. A fair proportion is used for the manufacture of butter and ghee. Hence, this figure of 3·5 oz. per head per day may be assumed to be the intake of a 'consumption unit'. This would allow for the consumption of butter-milk, some of which may be distributed free in establishments employing large herds of milch cattle or in creameries where butter is manufactured.

Other Foodstuffs: No account has been taken of the consumption of meat and eggs. While the majority of the population is non-vegetarian by faith, the economic situation is such as to preclude any large scale consumption of these articles of food. Data on their consumption are woefully lacking; where some figures were obtained as a result of detailed and pains-taking diet surveys, it was found that they were consumed in insignificant amounts. In an earlier computation it was found that the consumption of meat (including eggs) and fish in the Madras State amounted to only 0·133 and 0·29 Oz. respectively per "Consumption Unit" per day.* Figures for consumption of meat and fish today may not be expected to be very different. Any increase in production might have been offset by increased population. In view of this small intake, the nutrients furnished by them are not reckoned in the construction of Tables I and II.

* W. R. Aykroyd (1937): League of Nations Health Organization, C. H. 1253 (C) No. 2.

Betel leaves: The production and consumption of betel leaves deserve special mention. It is stated that 28,769 acres in the state are devoted to the cultivation of betel vine. It is a prolific yielder, giving an average of about 80 lacs of leaves per acre per annum. Even on a most conservating reckoning of 16 leaves to an ounce, the production and consumption of betel leaves is something quite significant. Little wonder then that the habit of chewing betel leaves smeared with slaked lime is wide spread. The ingestion of calcium through this means may be appreciable but as the amounts could not be correctly guessed, they have been omitted from the calculations of nutrient intake. An additional reason for omitting the calcium intake by this means is that betel-chewing is often accompanied by chewing of tobacco when salivation induced by the betel leaves and tobacco is mostly spit out and not taken in. There will then be no addition to calcium intake. Such a habit is prevalent only amongst the men-folk whereas the women, not normally addicted to tobacco chewing, consume in entirety the betel leaves smeared with slaked lime. With the latter, the addition to calcium intake by this means may be significant.

Table II gives the individual nutrients available per 'consumption unit' — protein, fat, carbohydrate, calcium, phosphorus, iron, thiamine, niacin and riboflavin — from the various foodstuffs as also the calorific value furnished by them. Figures for vitamin A activity and vitamin C have not been worked out, because production and consumption of even small quantities of leafy vegetables, and sometimes fruits too, would significantly inflate these figures.

Table III gives a consolidated statement of the various nutrients available per 'consumption unit'.

In working out the figures shown in Tables II and III, the analytical data given in Health Bulletin No. 23 (1951) were employed. The following assumptions have also been made. The chemical composition of rice has been calculated on the basis that the entire consumption of rice is in the raw, milled state. While it is obvious that rice is also consumed in its other states, viz., undermilled, parboiled, handpounded, etc., they have not been taken into account in these calculations as data on the amount of rice consumed in the different states are not available and as the aim of the present study is to obtain a conservative estimate; raw milled rice has a smaller content of most nutrients than other varieties of rice and hence its composition was employed for the construction of Table II.

In computing the nutrients furnished by the three oilseeds and nuts, it has been assumed that 90 per cent groundnut and coconut are crushed for converting into oil and only 10 per cent consumed per se. In

the case of gingelly seeds, the entire production has been assumed to be utilized for conversion into oil. These assumptions are, undoubtedly, arbitrary, as no authentic data exist on the relative proportions of the oilseeds and nuts used for expression of oil and those used for direct consumption. However, it is presumed that the assumptions made would not be far removed from practices obtaining in the homes representing the different socio-economic strata in the Madras State.

The composition of foodstuffs given in Health Bulletin No. 23 represents percentages of the edible portion. Allowance should, therefore, be made for the wastage or non-edible portion, especially when the latter is present in significant proportions. The non-edible portion is not considerable with most of the items reckoned in Table II except in the case of the two fruits, mango and banana, which contain about 25 and 40 per cent respectively. Hence, the gross production figures for mangoes and banana have been converted into net values, representing the edible portion only. In the case of the coconut, production figures have been worked out on the basis of kernel weight only and not on the whole nut which will have considerable non-edible portion.

Discussion: It will be seen from the data in Tables II and III that the diet available for the population of the Madras State appears to be *quantitatively* adequate, supplying as it does 2,641 calories per 'consumption unit' against a recommended allowance of 2,600 calories for an adult employed in moderate activities. It does not allow sufficient margin for seed requirements and for the inevitable wastage during transit, distribution, cooking losses, etc. From the point of view of *quality*, the diet is somewhat defective, as nearly two-thirds of the total calories are furnished by cereals alone. The diet is over-weighted with carbohydrates which contribute about 70 per cent of the total calories. The protein content of the diet is somewhat low and could with advantage be increased by 25 to 30 per cent. The amount of animal protein available is very low and might profitably be bettered. Likewise, the amount of animal fat available for consumption could be increased, though the overall picture regarding availability of fat is not unsatisfactory. To effect these improvements, an increased production and consumption of milk, meat, fish and egg is desirable. With a long coastline, it should not be difficult to increase the intake of fish by those who have no religious objection to partaking of it.

The minerals available from the diet, calcium, phosphorus and iron, may be stated to be adequate except perhaps in the case of calcium. When this is considered in conjunction with the widespread habit of chewing of betel leaves smeared with slaked lime, notwithstanding its limitations, and the consumption of some leafy vegetables, the calcium requirements of the population may be deemed to have been fairly

adequately met. As much as 28,769 acres are devoted to the cultivation of betel vine, producing over 4,00,000 tons of leaves rich in calcium, carotene and vitamin C. In addition to its being inherently rich in calcium, liberal amounts are employed for smearing the leaves, thus contributing substantially to total calcium intake, more especially in the case of those not addicted to chewing tobacco in addition. Calcium ingested through this means is physiologically available. Further, the intake of most vegetables, including leafy vegetables, has not been taken into considerarion, for lack of data. The leafy vegetables being rich in calcium and iron would make some contribution to total intake of these two elements. The intake of the cheap and easily cultivated leafy vegetables may with advantage be increased.

The amount of vitamins furnished by the diet is in general inadequate, more especially in vitamins of the B-group. The latter should nearly be doubled for ensuring satisfactory intakes, preferably by increased production and consumption of pulses. The supply of vitamins A and C has not been considered at all, as it is inextricably mixed up with the production and consumption of leafy vegetables and fruits, rich sources of carotene (pro-vitamin A) and vitamin C.

Notwithstanding these seeming deficiencies, the overall impression left in the mind after a critical appraisal is that the food situation in the Madras State is not so pessimistic or grave as is often made out in the lay press and elsewhere. Yet, it is definitely on the marginal side, allowing little or no provision for lean years and for natural calamities like drought, floods, etc., or for the inevitable inequalities of distribution. The food situation could and should be improved if the entire population were to be fed at nutritionally adequate levels. There is hardly room for complacency; in fact, complacency would be dangerous, especially in the context of the steadily growing population pressure.

TABLE I.

	Acreage (1,000 acres)	Annual yield per acre	Total annual production (million tons)	Available food per "consumption unit" per day (in ounces)
Cereals:				
Rice ..	10,500	1,000 lbs.	4·690	10·806
Sorghum ..	4,828	400 ,,	0·862	1·987
Cumbu ..	2,597	300 ,,	0·350	0·806
Ragi ..	1,748	1,000 ,,	0·780	1·797
Italian millet ..	1,543	600 ,,	0·413	0·952
Kodo millet ..	987	600 ,,	0·264	0·608
Samai ...	565	400 ,,	0·101	0·233
Wheat ..	12	400 ,,	0·002	0·005
Maize ..	58	1,200 ,,	0·031	0·070
	22,838		7 493	

	Acreage (1,000 acres)	Annual yield per acre	Total annual production (million tons)	Available food per "consumption unit" per day (in ounces)
Pulses:				
Red gram ..	337	900 ,,	0·1354	0·312
Horse gram ..	1,549	350 ,,	0·2420	0·557
Green gram ..	506	320 ,,	0·0723	0·167
Black gram ..	292	320 ,,	0 0417	0·096
Bengal gram ..	65	550 ,,	0·0160	0·037
	2,749		0·5074	
Oilseeds and Nuts:				
Groundnut ..	3,743	900 ,,	1·5040	3·466
Gingelly seeds ..	718	100 ,,	0·0321	0·074
Coconut ..	606	1,500 ,, (of kernel)	0·4058	0 935
	5,067		1·9419	
Condiments and Spices:				
Chillies (dry) ..	289·0	1,200 lbs.	0·1549	0·356
Onions ..	43·69	9,000 ,,	0·1756	0·405
Turmeric (dry) ..	33·642	4,000 ,,	0·0601	0·139
			0·3906	
Sugar and Jaggery:	203·0	6,000 ,, (jaggery)	0·5438	1·254
Vegetables:				
Potato ..	14·997	12,000 ,,	0·0804	0·185
Tapioca ..	25·475	6,000 ,,	0·0670	0·155
			0·1474	
Fruits:				
Mangoes ..	250·0	12,500 ,, (gross) and	1·3890 (gross) 1·0420 (net)	2·401
Bananas (including plantain) ..	150·0	15,000 ,, (gross) and	1·0000 (gross) 0·6000 (net)	1·382
Milk:	—	—	—	3·5
Betel leaves:	28·769	31,250 ,,	0·4013	0·926

TABLE II.

	Per cons. unit	Protein	Fat	Carbohydrate	Ca.	P.	Fe.	Thiamine Int.	Nicotinic acid	Riboflavin	Calories
	Oz.	g.	g.	g.	mg.	mg.	mg.	Units	mg.	g.	
Cereals:											
Rice ..	10·806	21·61	1·08	237·74	32·42	335·00	3·24	64·84	3·24	248·55	1,069·84
Sorghum ..	1·987	5·96	0·99	41·73	15·90	156·98	3·57	65·58	0·99	206·66	200·71
Cumbu ..	0·806	2·66	1·13	15·41	11·29	79·85	2·50	25·00	0·72	—	82·27
Ragi ..	1·797	3·59	0·72	39·00	168·95	138·40	2·69	71·89	0·54	—	176·14
Italian Millet ..	0·952	3·33	1·24	16·37	7·61	78·06	1·71	52·36	0·19	—	90·43
Kodo Millet ..	0·608	1·46	0·24	5·23	6·08	42·59	0·91	18·86	—	—	52·93
Samai ..	0·233	0·51	0·31	4·22	1·40	23·33	0·46	6·54	—	—	21·70
Wheat ..	0·005	0·02	0·002	0·09	0·06	0·42	0·006	0·23	0·006	0·16	0·45
Maize ..	0·07	0·23	0·07	1·34	0·21	6·63	0·05	—	0·03	2·0	6·92
	17·265										1,701·39
Pulses:											
Red gram. ..	0·312	1·96	0·16	5·06	12·48	21·84	0·78	13·42	0·22	44·31	29·64
Horse gram ..	0·557	3·51	0·06	9·03	44·60	61·32	1·17	—	0·22	—	50·73
Green gram ..	0·167	1·13	0·06	2·68	6·67	13·33	0·40	7·33	0·10	18·33	15·83
Black gram ..	0·096	0·66	0·04	1·65	5·78	9·63	0·27	3·85	0·06	10·31	9·54
Bengal gram ..	0·037	0·18	0·06	0·65	2·00	2·52	0·10	1·04	0·03	5·39	3·81
Oilseeds:											
Groundnut ..	3·466	2·63	3·92	2·01	4·85	38·09	0·18	88·65	1·39	29·44	54·02
		(1/10)	35·25								317·27
Gingelly ..	0·074		0·91	—	—	—	—	—	—	—	8·17
Coconut ...	0·935	0·13	1·10	0·34	0·28	6·36	0·05	0·37	0·02	2·62	11·79
		(1/10)	9·94								89·42

TABLE II (Contd.)

	Per cons. unit Oz.	Protein g.	Fat g.	Carbohydrate g.	Ca. mg.	P. mg.	Fe. mg.	Thiamine Int. Units	Nicotinic acid mg.	Riboflavin g.	Calories
Condiments:											
Chillies (dry) ..	0·356	1·60	0·64	3·20	16·04	35·65	0·25	—	—	—	24·96
Onions ..	0·405	0·20	0·04	1·50	4·05	8·09	0·12	4 45	0·04	1·21	6·88
Turmeric (dry) ..	0·139	0·25	0·19	2·73	5·97	11·11	0·73	—	0·09	—	13·75
Sugar and Jaggery ..	1·254	—	—	35·60	—	—	—	—	—	—	142·42
Vegetables:											
Potato ..	0·185	0·09	0·02	1·20	0·60	1·67	0·04	1·11	0·06	0·60	5·18
Tapioca ..	0·155	0·03	0·02	1·68	1·55	1·55	0·03	0·62	0·02	4·33	6·95
Fruits:											
Mangoes ..	2·401	0·48	0 24	7·93	7·20	14·41	0 24	—	0·24	33·61	33·61
Bananas ..	1·382	0·42	0·14	9·68	4·12	11·06	0·14	—	0·14	66·36	41·44
Miscellaneous: ..											
Milk ..	3·5	3·15	3·50	4·90	119·00	87·50	0·35	17·50	0·35	199·50	63·00
Betel leaves ..	0·926	0·83	0·18	1·57	60·19	10·19	1·48	—	0·18	8·33	11·11
Total ..		56·62	62·252	452·54	538 30	1,196·58	21·466	443·64	8·876	881·71	2,640·91

TABLE III.

Showing available nutrients per "consumption unit" per day.

Protein	..	56·62 g.
Fat	..	62·25 g.
Carbohydrate	..	452·54 g.
Calcium (Ca)	..	538·30 mg.
Phosphorus (P)	..	1,196·58 mg.
Iron (Fe)	..	21·47 mg.
Thiamine	..	443·64 Int. Units.
Nicotinic acid	..	8·88 mg.
Riboflavin	..	881·71 mg.
Calories	..	2,640·91

Research Note

Variations of Soil Temperature at Coimbatore

Soil temperature has an important part to play in the maintenance of moisture status in the soil. Optimum level of moisture in the soil is very essential for successful crop production. Roots and shoots of plants depend on soil-moisture for their normal development.

To gain an idea of the variations of soil temperature due to depths and seasons, the soil thermogragh charts pertaining to the depths of 4″, 6″ and 24″, maintained for a period of nine years, were examined and relevant data for intervals of two hours were culled out. The soil is of light black colour, best suited for the cultivation of cotton under irrigated conditions. Twelve sets of data were collected for each depth, each set comprising a period of nine years. Fisher's analysis of variance was used to study the variations in hourly and weekly temperature. By students 't' test the significance of the difference between the means at 4″, 6″ and 24″ depths, taken in pairs, was tested. Finally by calculating the correlation coefficients of mean temperatures at these three depths, the degree of association was assessed.

Tentative Findings: (i) The soil temperature is maximum at the period 12–16 hours. There is no significant difference in the temperatures noted in this period.

(ii) The soil temperature is minimum at 4-8 hours. The difference in the temperatures observed in this period is also not significant.

(iii) The weekly fluctuations of the soil temperature are significant.

(iv) The dispersion of temperature round the mean at 4″ depth is greater than the same at the two successive bottom depths, namely, 6″ and 24″.

(v) The soil temperature at 4″ depth is significantly greater than the temperature at 24″ depth $\left(\frac{x}{\sigma} = 2{\cdot}665 \right)$. The difference between the temperatures at 4″ and 6″ depths is not statistically significant.

(vi) The coefficient of variability is greatest for the temperature at 4″ depth and it gradually decreases as the depth increases.

(vii) A very high positive correlation exists between the temperatures recorded at 4″ and 6″ depths ($\gamma = +0{\cdot}9126$). The correlations between the temperatures at 6″ and 24″ ($\gamma = +0{\cdot}7968$) and 4″ and 24″ ($\gamma = +0{\cdot}8239$), depths are also positive and significant. But the degree of relationship is less pronounced in the latter two cases.

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Rajagopalan N. Proc., 22nd Indian Sci. Cong. 1935, P. 352; Ramdas L. A. and David R. K. 1934 Curr. Sci. *3*.

Agricultural Meteorology Section, Coimbatore, Dated 20—2—1954.

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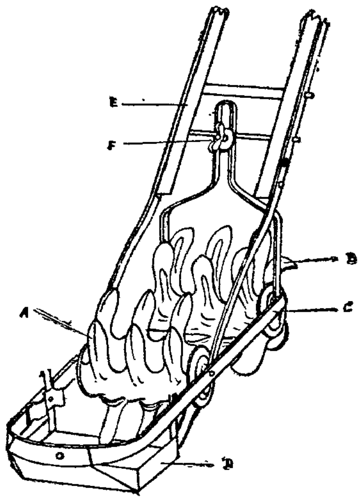
The Japanese Type Rotary Weeder

The Japanese rotary type weeder is a simple implement capable of being handled by one man and used for interculturing in paddy-fields where the seedlings are sown in rows 10″ apart. The implement thoroughly loosens soil in between the rows, and pulls out and buries the weeds. It can cover an area of 60 to 75 cents in a day of 8 hours and does not impose any undue strain on the operator. This weeder approximately weighs 11 lb. and cost Rs. 35/- to manufacture.



A. Front weeding drum
B. Rear weeding drum with back swept fingers
C. Frame work
D. Float
E. Handle
E. Adjustment for hight

The rotary weeder consists of two weeding drums each made up of 6 sets of 3 sheet metal fingers. The drums are each 4½″ long and 7″ dia Weeding drums of greater or lesser width can be used where the spacing between rows is greater or lesser than 10″. The two drums are mounted one behind the other 10″ apart on a sheet metal frame work 5½″ wide and 20″ long. The fingers of the forward drum loosen the soil and pull out the weeds and the fingers of the other which are swept back slightly at the tip churn up the soil and bury the weeds. A boat shaped float 5½″ wide 6½″ long is attached to the frame work in front of the leading drum. This float guides the implement over the loose soil and prevents it from sinking unduly. The frame work is attached to a wooden handle and the angle between the handle and frame work is capable of adjustment to suit the convenience of the operator. The implement is pushed forward and pulled backward alternately by the operator, as he walks along in the space between the two rows. The weight of the implement is sufficient to obtain the necessary penetration and no downward thrust should be applied on the handle during the push and the pull, lest the rear drum should sink too deep and the implement should get bogged. With a little practice the correct technique is easily acquired.

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Note:- "Experiments are under way to determine the value of weeding and interculture in different areas and seasons. Till the results of these experiments are available, the department is not in a position to recommend this operation or an implement for the operation. The Rotary Weeder mentioned in the article may be useful to those who wish to weed their paddy crop, besides being of help in the conduct of trials in our Agricultural Research Stations." (Ed.)

EXTRACTS AND GLEANINGS

Trashy leaf Tobacco: Trashy leaf results from the curing of leaf abnormally low in hexose sugars and high nitrogen. Its occurrence may be reduced by cultural practices which restore a favourable balance of carbohydrates and nitrogen in the plant. The affected leaf is brown in colour, has either a papery or hard brittle texture, and is lighter in weight than normal leaf. The transition from trashy to good leaf is gradual, producing various gradations of trashiness. Severely affected leaf is unsuitable for the manufacture of tobacco and represents a total loss to the grower.

Recent research has shown that trashy leaf is not due to disease, insect pests, or faulty technique in harvesting and curing, but rather to a abnormal chemical consitution brought about by unfavourable climate and cultural conditions. At the green stage trashy leaf is difficult to distingush in appearance from normal leaf. It is only on curing that the typical colour and texture of the trashy leaf develop. The investigation was facilitated when it was found that potentially trashy and normal uncured leaf differ in appearance under ultra-violet light. The underside of uncured quickly-dried leaves high in carbohydrates and low in nitrogen glows (fluoresces) strongly when exposed in the dark to ultra-violet light. On the other hand, potentially trashy leaf, low in carbohydrate and high in nitrogen, fluoresces only feebly or not at all. Leaves of intermediate composition exhibit an intermediate degree of fluorescence. Thus the degree of fluorescence in uncured tobacco leaves is a most useful measure of potential quality. In the uncured state trashy leaf is characterized by an extremely low sugar content and a relatively high nitrogen level. During the curing process the deficieny of sugars leads to an undesirable breakdown of the tissues, with a loss of yellow pigments.

Some types of leaf low in sugars and high in nitrogen yield, on curing, a thin, papery, brown-coloured, trashy leaf consisting mainly of cell-wall material which has paper-like smoking qualities without any specific odour. Other types, especially those very high in nitrogenous compounds, produce a thick horny leaf harsh to the touch with brown to reddish areas. Often, on smoking, such leaf gives objectionable odours reminiscent of burnt wool or meat. It is much disliked by manufacturers as it imparts undesirable odours even when present in very small proportions. The incorrect but prevalent belief that over-ripening and or over-curing have caused trashiness has led to under-curing and harvesting of immature leaf. The resulting leaf has a strong green cast and is generally also low in carbohydrate and high in nitrogen.

While nitrogen is available the plant continues to absorb it, and this may lead to the production of leaf with high nitrogen content and a low sugar-nitrogen ratio or in other words, to the production of non-cigarette leaf. From the point of view of leaf quality a deficiency of nitrogen is to be preferred to an excess, and the ideal situation is one in which there is ample nitrogen during the growing period with a deficiency just prior to harvesting. In this respect, nitrogen fertilizers should be used judiciously and only enough applied to ensure satisfactory growth. If side dressings are necessary during growth the fertilizer should be in a readily assimilable form, be quickly available to the plant, and be depleted before the harvest.

Shading tends to lower the carbohydrate level, since it reduces photosynthesis. In a shading experiment in north Queensland the leaves of plants exposed to direct sunlight contained nearly three times as much carbohydrate and three-fifth the amount of nitrogen as plants covered to simulate field shading

On curing, the shaded leaves were trashy but those exposed to direct sunlight produced good cigarette tobacco.

Shading may be minimized in the field by planting the rows wherever possible in an east-west direction and by placing the plants as far apart as other agronomic requirements allow. Low topping is suggested as a further means of reducing shading and it also prevents the transport of sugars to the apex at the critical period.

In general, lack of balance of nutrients and deficiency or excess of major trace elements have immediate adverse effect on the leafy part of the plant. The necessity for constant access to water is evident as, quite apart from general physiological disorganization, the effect of prolonged drought on plants is impoverishment in carbohydrates and accumulation of nitrogen. (Agricultural News Letters, Australia, Release No. AGN/539.)

The chemical method of caponisation (by injecting the hormone Stilboestrol) produced birds equal in growth and quality with birds which had been surgically caponised. There is some gain by the chemical method of caponiszation in that (a) there is less likelihood of losses which may occur when birds are surgically caponised, and (b) there is no check or setback for birds which are chemically caponised. The effect of injecting stilboestrol tablets becomes obvious within the first month after the injection.

There is a significant difference in the quality of the carcass of a capon and that of a cockerel, both in market appearance when it is killed and plucked and also in palatability when it is cooked and eaten.

Australorp x. White Léghorn cockerels, if caponised, reach their prime for marketing and palatability as capons at from 21 to 22 weeks of age when treatment with stilboestrol is started at 10 weeks of age. (New Zealand Journal of Agriculture, Vol. 88, No. I, 1954.) (T. R. N.)

CROP AND TRADE REPORTS

Crop Statistics, Madras State, 1953—'54. Blackgram — First and Final forecast: The area sown in the Madras State upto 25th December, 1953 is estimated at 141,000 acres and shows an increase of 2·0% over previous year and a decrease of 6·2% on the previous five years. The increase in area this year is due to timely rains at the time of sowing. The crop is mainly grown in the districts of Tiruchirapalli, Tanjore, Madurai, Tirunelveli, Malabar and South Kanara. A decrease in area is estimated in the districts of Tiruchirapalli and Madurai and an increase in the other districts of the State. The crop has been harvested in some districts of the State. The crop is reported to have been affected to some extent in South Kanara district for want of moisture in the soil. The yield per acre is expected to be normal in the district of Salem, Coimbatore and Tanjore and slightly below the normal in the other districts of the State. The seasonal factor for the State as a whole works out to 96% of the normal as against 81% estimated for the previous year. On this basis, the total yield works out to 14,500 tons of cleaned grain giving an increase of 20·8% and 14·2% respectively over previous year and average yield. The average wholesale prices of dhall per maund of 82$\frac{2}{7}$ lb. on 9th January 1954 at important market centres, compared with the prices which prevailed in the corresponding period of last year show a decrease of 2·2 per cent in Tirunelveli.

Greengram — First and Final forecast: The area sown in the Madras State upto 25th December 1953 is estimated at 127,100 acres showing an increase by 4·2 % over last year a decrease of 0·2 % compared with previous five years. The crop is mainly grown in the districts of Coimbatore, Tanjore and Tirunelveli. An increase in area is estimated in all the districts of the State, except in the districts of Chingleput, Tiruchirapalli, Tirunelveli, and South Kanara where the area was the same as that of last year. The crop has been harvested in some districts of the State. The crop is reported to have been affected by inadequate moisture in the soil in the district of South Kanara. The yield per acre is expected to be normal in the districts of Salem and Coimbatore and slightly below the normal in the other districts of the State. The Seasonal Factor for the State as a whole works out to 96 % of the normal as against 85 % of the normal for the previous year. On this basis, the total yield works out to 10,000 tons of cleaned gram giving an increase by 17·4% over last year and compared with the average yield for the five years ending with 1951—52, an increase by 14·8%. The average wholesale price of dhall per maund of 82$\frac{2}{7}$ lb. on the 9th January 1954 was Rs. 20—1—0 in Salem.

Horsegram — First and Final Forecast: The area sown in the Madras State upto 25th December 1953, is estimated at 553,200 acres, showing an increase of 4·7% over last year and 5·9% over the previous five years. The increase in acreage under the crop is due to timely rains received at the time of sowing. An increase in area is estimated in all the districts of the State except Tanjore, and Malabar where the area was the same as that of last year. The crop is reported to have been affected by want of moisture in the soil in the districts of Malabar and South Kanara. The yield per acre is estimated to be normal in the districts of Salem, Coimbatore, Tiruchirapalli and Tanjore, and slightly below the normal in the other districts of the State. The Seasonal Factor for the State as a whole works out to 98 % of the normal as against 76 % of the normal estimated for the previous year. On this basis the yield works out to 48,700 tons and compared with last year and the average yield for the previous five years, shows an increase of 35·7% and 48·5% respectively.

Bengal gram — Second Forecast Report: The area sown in the Madras State upto the end of February 1954 is estimated at 5,200 acres and compared with previous year and average area for the five years ending with 1952—'53, shows an increase of 15·6% and a decrease of 1·9% respectively. The increase in area in the current year is attributed to timely rains at the time of sowings. The crop is not grown in the districts of Chingleput, Tanjore, Malabar, South Kanara and the Nilgiris. An increase in area is estimated in the districts of South Arcot, Salem, Coimbatore and Ramanathapuram and the area was the same as that of last year in the districts of North Arcot, Tiruchirapalli, Madurai and Tirunelvelly. The condition of the crop is generally satisfactory in all the districts of the State. The yield per acre is expected to be normal in the districts of South Arcot, Salem and Ramanathapuram. The condition of the crop is generally satisfactory in all the districts of the State. The yield per acre is expected to be normal in the districts of South Arcot, Salem and Ramanathapuram. The Seasonal Factor for the State as a whole works out to 98 % of the normal as against 71 % for the corresponding period of the previous year. On this basis the total yield works out to 1100 tons and compared with the estimated production of the previous year and an average estimated production for the five years ending 1952—'53 shows an increase of 83·3% and 22·2% respectively. The wholesale prices of dhall per maund of 82$\frac{2}{7}$ lb. or 3200 tolas for the week ending 6th March 1954 compared with the price which prevailed in the corresponding period of the previous year, in Salem, shows a decrease of 305 %.

Gingelly — Final Forecast Report: The area sown in the Madras State in 1953—'54 is estimated at 421,500 acres and compared with the final area for 1952—'53, shows an increase of 41·0% with the average area for the five years ending with 1952—'53 an increase of 18·8%. The increase in area this year is mainly due to favourable seasonal condition. A decrease in area is estimated in the districts of South Arcot, Tirunelveli, and Malabar and an increase in the other districts of the State except in South Kanara where the area estimated is the same as that of last year. The crop is reported to have been affected by insect pest and excessive rains in the district of Tirunelveli. The yield per acre is estimated to be higher than that of last year in all the districts of the State. The Seasonal factor for the State as a whole works out to 96 % of the normal as against 78% of the normal estimated for the previous year. On this basis, thetotal yield works out to 52,500 tons representating an increase of 75·6% over the previous year and yield of 41·1% over the previous five years. The wholesale price per standard maund of 82$\frac{2}{7}$ lb. or 3,200 tolas as reported from important market centres compared with the prices which prevailed on 11th April 1953 show a decrease of 16·5% in Tiruchirapalli, 13·0% in Tirunelveli, 10·0 % in Tuticorin and 3·1 percent in Salem. (Director of Statistics, Madras).

Weather Review — For the month of May, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	0·0	— 1·0	2·9
	Tirurkuppam*	0·0	— 2·2	3·1
	Vellore	2·6	+ 0·3	5·6
	Gudiyatham*	1·7	— 1·0	5·1
East Coast	Palur*	0·1	— 1·9	7·4
	Tindivanam*	0·0	— 1·2	8·1
	Cuddalore	0·2	— 0·8	14·3
	Nagapattinam	0·1	— 1·5	6·6
	Aduturai*	0·9	— 0·8	7·9
	Pattukottai*	3·1	+ 1·9	14·9
Central	Salem	2·9	— 1·7	5·9
	Coimbatore (A. M. O.)*	3·6	+ 1·7	10·4
	Coimbatore	3·6	+ 1·1	14·2
	Tiruchirapalli	5·3	+ 2·7	11·2

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	4·9	+ 2·2	11·7
	Pamban	1·4	+ 0·4	11·7
	Koilpatti*	7·8	+ 5·6	18·2
	Palayamcottai	1·1	— 0·5	10·5
	Ambasamudram*	0 2	— 1·6	18·5
West Coast	Trivandrum	5·9	— 2·9	22·4
	Fort Cochin	14·4	+ 2·7	28·1
	Kozhikode	12·6	+ 3·7	20·3
	Pattambi*	1·5	— 4·4	9·1
	Taliparamba*	7·7	+ 0·9	12·3
	Wynaad*	5·4	+ 0·4	10·1
	Nileshwar*	4·0	— 2·2	14·3
	Pilicode*	4·0	— 1·4	13·6
	Mangalore	5·7	— 2·0	10·4
	Kankanady*	3·5	— 2·3	8·5
Hills	Kodaikanal	6·9	+ 0·5	25·1
	Coonoor*	4·9	+ 1·6	27·9
	Ootacamund*	3·9	— 0·8	11·7
	Nanjanad*	3·1	— 1·2	9·6

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

Conditions were markedly unsettled in the north Andaman Sea on the first day of the month. They concentrated into a depression in about two days and passed away north-eastwards to the coast of Burma. The unsettled conditions, which again appeared in the east central Bay of Bengal on 6–5–1954 persisted for two days and became unimportant on 8–5–1954. A feeble advance of the monsoon occurred in the south Andaman Sea on 15–5–1954. The conditions were slightly unsettled in the east central Bay of Bengal on 17–5–1954. The monsoon continued to be weak in the south Andaman Sea upto 21–5–1954 and thereafter conditions were favourable for the advance of the monsoon into the south-east Bay of Bengal. A trough of low pressure formed in the east Arabian Sea off the Kanara-Konkan Coast on 23–5–1954 but got filled up in two days. The monsoon strengthened in the Andaman Sea on 28–5–1954 and advanced into the southeast and east central Bay of Bengal, where the conditions were markedly unsettled. A trough of low pressure favourable for the advance of the monsoon, but became less again appeared off the Malabar–Kanara Coast on 29–5–1954, marked on the following day. The monsoon advanced over Travancore-Cochin as a feeble current on 31–5–1954. A series of six western disturbances passed over the extreme north of the country during this month. Thundershowers were fairly well distributed in Tamil Nad, Malabar and south Kanara. The note-worthy rainfalls and the Zonal rainfall for the month are furnished hereunder.

Note-worthy Rainfalls for the Month

Date	Name of Place	Rainfall	Name of Zone	Av. rainfall for April	Dep. from normal	Remarks
1/5/54	Fort Cochin	3·72″	North	1·08	— 1·00	Below normal
,,	Trivandrum	2·54″	East Coast	0·73	— 0·72	,,
5/5/54	Koilpatti	2·33″	Central	3·85	+ 0·95	Above normal
13/5/54	Nileshwar	2·28″	South	3·08	+ 1·22	,,
23/5/54	Kodaikanal	2·48″	West Coast	6·47	— 3·01	Below normal
24/5/54	Pattukottai	2·23″	Hills	4·70	Nil	Normal

Agricultural Meteorology Section
Lawley Road P. O.,
Coimbatore, 11—6—1954

C. B. M. & M. V. J.

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Announcement

RAMASASTRULU MUNAGALA PRIZE COMPETITION

The last date of submission of essays has been extended upto 31st July 1954.

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The Madras Agricultural Journal

Vol. XLI July 1954 No. 7

Editorial

For successful plant growth, especially, on large areas as in agricultural or plantation crops where a single variety may occupy large and continuous tracts the problem most imminent is the control of pests and diseases. For, if a pest or a disease appears in one part it is easy for it to spread over the whole area in a short time since a uniform host is available uninterrupted. They then attain an epidemic form unless they are checked early and serious losses may result. To combat these, various measures have been adopted in the past. The most frequent measure against diseases have been one of prevention by spraying of chemicals etc , and of breeding a resistant variety. In the case of pests it is again one of destruction of and prophylaxis against possible future attacks. Chemical treatments and biological control methods have been usual. Most agricultural crops are annual whereas the plantation crops are perennial. Thus in the battle for preservation of the plant a constant vigilence and fight has to be kept up. It is possible that in either instance the pest or the disease may disappear temporarily and reappear when favourable situations obtain. R. L. Piemeisel has reviewed (Bot. Rev. 1954; vol. 20; no. 1 ; p. 1-50) a measure which is not so well known as the ones mentioned above. This measure has been called "Replacement control". This is a measure which employs indirect means of getting rid of pests through changes in vegetation. This involves replacement of weeds and other vegetation by other more desirable, useful and resistant species. These new plants are, so to say, strangers to the pests and diseases and thus are not attacked by them during the seasons when the susceptible crop is off the field. Thus there is considerable reduction in the pests and diseases for want of an alternate host. The replacement itself is not so easy nor can it be done in a short time. Careful selection of the plant species to form communities has to be done. Numerous difficulties of course arise in such whole-sale replacement of existing communities. One is aware in India the

seriousness of pests like the aphids, jassids etc. These are known to live on the grasses growing near the cultivated field and transported to the crops during the crapping season. Considerable difficulties have been experienced in controlling them. In such cases the replacement control deserves a serious trial. A graphic illustration has been given of such a control. In this instance destruction by man of large areas of vegetation in semidesert areas led to the inhabitation of the marginal lands by certain weeds which were suitable hosts for the beet leaf hopper. These multiplied and obtained plague proportions and travelled from sugar beet to other crops like tomatoes, beans etc. This hopper was a carrier for a virus which caused curly leaf top and thus spread the virus from plant to plant. The replacement control measure brought this under effective check. Thus the agriculturist has in his hands another valuable measure of control of pests and diseases and calls for careful consideration of the species of plants that are utilised in planting up of new areas and at the same time being useful as fodder etc.

Fertiliser Studies with Potatoes — *(Studies on the reduction of manure without detriment to crop yield or the productivity of the soil*

By

M. SANYASI RAJU, S. VARADARAJAN & Mrss. V. K. KUNJAMMA
Agricultural Chemistry Section, Agricultural Research Institute, Coimbatore

Introduction: The potato cultivation in this State, unlike in most of the other States, is confined mainly to the hills of Nilgiris, barring some few hundreds of acres in Kodaikanal and Hosur. The climate of the Nilgiris being equitable and mild, the potatoes can be grown throughout the year. However, the most favourable season is March to June. The total area as per the latest available statistics is about 19,500 acres with an yield of over 52,000 tons. The area under cultivation has steadily been increasing since 1923–'29 when it was fluctuating between 8,111 and 8,644 acres. In 1930–'31 it was 10,600 acres but rose gradually to 15,400 acres in 1937–'38 and to 19,500 in 1945–'46 which level is being maintained at present. The object of the experiment was to study the possibilities of reducing the dosage of manure for growing potatoes in the Nilgiris without impairing the efficiency of yields or the productive capacity of the soil.

Soil Condition: The soils of the Nilgiris are of laterite origin. They are open soil though the clay content is high, deficient in lime (0·04 to 0·09%), and are acidic, pH ranging from 4·5 to 5·2. The sesquioxide content is very high, iron and alumina varying from 7 to 10% and 11 to 15% respectively. These and the lateritic nature of the soils render the added phosphate unavailable and therefore require large doses of it.

Further, the slopes on which potato is grown coupled with high rainfall results in washing out of the soluble manures and hence high doses of manures have to be applied to secure good yields. Therefore, experiments were designed to cut down the manurial bill without impairment of either the yields or the productive potentiality of the soils.

Materials and Method: The Great Scot variety of potato which is the most popular and high yielding one on these hills, was grown.

Treatments:

(a) *Two rates of nitrogen application:*

(1) 40 lb. of nitrogen per acre in the form of ammonium sulphate and groundnut cake.

(2) 80 lb. of nitrogen per acre as above.

(b) *Three levels of P_2O_5 and no phosphoric acid:*

(1) No P_2O_5 application.

(2) 40 lb. of P_2O_5 in the form of superphosphate and bone meal.

(3) 120 ,, ,,

(4) 200 ,, ,,

(c) *Lime vs. No lime application:*

(1) No lime application.

(2) Lime at 2 tons per acre (slaked lime).

(d) *All plots received potash at 100 lb. K_2O per acre as potassium sulphate.*

This was a complex manurial experiment of $2 \times 4 \times 2 = 16$ treatments. Each treatment was replicated 8 times resulting in 128 plots. Each plot consisted of 6 rows—20 feet in length by 12′ width or 0·55, cents in area. All the plots received a basal dressing of 5 tons of cattle manure at the time of preparation of the field for the lay out. There were two series of plots in the same field with identical treatments so that in three seasons, three crops of potato could be raised with the usual rotation followed on the hills :—

	Series I	Series II
I year:	potato — Lupin	Samai — Lupin
II year:	samai — Lupin	Potato — Lupin
III year:	potato — Lupin	Samai — Lupin

Soil Analyses: Samples of soils from the field were taken at three depths viz. 0–12″, 12″–24″ and 24″ to 36″ before the beginning of the experiment in 1949 for complete machanical and chemical analyses (vide table III). The soil contained on an average 0·167% of nitrogen, 0·013% of available P_2O_5 and 0·0096% af available K_2O with a total lime content of 0·114% and organic carbon content of 1·77%. The soil reaction was pH 5·52.

Samples of soils were also collected from all the plots immediately after the harvest of potatoes in all the three years and

analysed for nitrogen, total lime, total and available P_2O_5, organic carbon and pH. The methods as described in A. O. A. C. was adopted for all analyses except for organic carbon for which Walkley and Black's method was adopted.

Results: Three crops of potatoes were raised during the three years of trial. The yield data are presented in table I. The statistical interpretation of the yields are given in table II. The data on the analysis of soil samples taken after the harvest of the potatoes to study the changes in the productive capacity of the soil are presented in tables IV and V. The formula of the usually prescribed manure applied to potatoes, known as the Nanjanad mixture, is given below :—

Groundnut cake 500 lb.; Ammonium sulphate 200 lb.; Concentrated super 336 lb.; Steamed bone meal 224; Potassium sulphate 224 lb.

The first crop of potatoes raised in 1949 gave an average yield of 15,240 lb. per acre in the plots receiving 80 lb. nitrogen, 200 lb. phosphoric acid and 100 lb. potash, which is the control used for comparing the yields when the different ingredients were reduced systematically. From the yield data it is seen that (1) the effect of liming was not in any way significant on the yields. In fact lime had a depressing effect on the high levels of phosphoric acid and nitrogen. Eighty pound dose of nitrogen proved superior to 40 lb. dose of the same. The yield response to phosphoric acid increased proportionately with higher doses of the ingredient. However, there was no significant variations in yield due to the various combinations of the manurial ingredients used.

The second crop raised in 1950 gave a poor yield due to the failure of seasonal rains. The yield recorded in the whole of the Nilgiris was generally low. The average yield of potatoes receiving the maximum quantity of nitrogen and phosphoric acid was only 8,860 lb., a figure about 56% of the first year's yield from plots receiving similar treatments. The yield was statistically significant to the main effects of phosphoric acid and its interactions with nitrogen only. The effect due to other treatments were not significant. In the second year also the yield due to phosphoric acid increased with the dosage.

The third crop of potato planted in 1951 gave an average yield of 10,000 lb. per acre in the plots receiving the Nanjanad

mixture. The data reveal that higher doses of nitrogen in combination with the higher doses of phosphoric acid have given increased yields. There are indications that when the level of nitrogen was low, lime had better influence. This is evidently due to the effect of lime in rendering the insoluble organic nitrogen present in the soil to nearly 0·2% available to the growing crop. Again it was seen that phosphoric acid gave increased yield as the dosage was raised.

The statistical examination of the yield data revealed that there was significance for the main effects of nitrogen and phosphoric acid only. The effects due to other treatments were not significant. Limed plots did not give any better yield than the unlimed plots.

Soil analyses indicate that the fertility status of the soil after potato harvest had improved. There was not much variation in the different treatments. The summary of results are given in table VI.

Conclusions: From the three years trials the following conclusions may be drawn. (1) The higher the dose of nitrogen the greater is the yield of potatoes. (2) The yield of potatoes increases with the increase in dosage of phosphoric acid. (3) Lime by itself or in conjunction with either nitrogen or phosphoric acid does not influence to any great extent the yield of potatoes. (4) There is no indication to show that there was any impairment to the fertility status of the soil after a crop of potato.

Summary: (1) Experiments were conducted with potatoes to see the yield relationship with the different levels of nitrogen and phosphoric acid alone and, in combination with lime, for three years.

(2) The tangible conculsion derived from the trials is that the Nanjanad mixture with 80 lb. of nitrogen, 200 lb. of phosphoric acid and 100 lb. of potash seems to contain the minimum of ingredients necessary for good yield of potatoes on the hills and no further reduction in either the nitrogen or phosphoric acid seems possible consistent with good yields.

(3) Lime, even at two tons per acre, which would tell on the cost of manuring to a high degree, never gave any sizable increase in the crop yield and hence seems unnecessary in the existing scheme of manurial practice.

Acknowledgments: The experiment was designed and started by late P. D. Karunakar with the object of reducing the manurial bill of the potato cultivators of the Nilgiris. The authors' thanks are due to the Superintendent, Agricultural Research Station, Nanjanad for all the help rendered in the conduct of the trials. They are also indebted to Sri C. Raghavendrachar who analysed the soils of the experimental plots prior to the commencement of the experiment and to and Sri S. Subramaniam who attended to certain operations in the conduct of the trials. Thanks are also due to the Government of Madras for sponsoring a scheme to carry out the studies for three years.

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TABLE I. Average yield of potatoes in the different series during the three years of experiments

Treatment (Ingredients in lb. per acre)			1949 — '50		1950 — '51		1951 — '52	
Nitrogen	Phosphoric acid	Potash	Unlimed	Limed	Unlimed	Limed	Unlimed	Limed
80	200	100	15,240	13,880	8,660	7,865	11,450	10,718
80	120	100	14,280	14,340	6,705	7,956	9,850	10,442
80	40	100	12,580	11,360	7,342	7,478	9,707	9,137
80	0	100	8,908	10,070	4,999	4,000	7,051	7,341
40	200	100	14,010	15,250	6,887	7,820	9,661	10,273
40	120	100	13,140	13,900	6,842	8,569	9,160	10,436
40	40	100	11,140	10,470	5,862	6,744	7,992	8,124
40	0	100	7,745	9,051	5,047	6,138	6,188	7,380

TABLE II. Complex Manurial Experiments—(Potatoes) Summary of Results

FIRST YEAR (1949—1950) LIME VERSUS NO LIME

Particulars	Mean Yield of Potatoes		General Mean	S. E. of Treatment	Whether Significant or Not	Critical Difference P = 0·05
	Lime	No lime				
Yield in Pounds per acre ..	12,290	12,130	12,210	253·4	No	—
As percentage on general mean ..	100·7	99·3	100	—	—	—
As percentage on control ..	101·4	100	—	—	—	—

Conclusions: Yields Not significant for lime.

NITROGEN

Particulars	Mean Yield of Potatoes		General Mean	S. E. of Treatment	Whether Significant or Not	Critical Difference P = 0·05
	1N	2N				
Yield in Pounds per acre ..	11,840	12,580	12,210	253·4	Yes	710·9
As percentage on general mean ..	96·9	103·0	100	—	—	—
As percentage on control ..	100	106·3	—	—	—	—

Conclusions: 2N, 1N.

TABLE II *(Contd.)*

PHOSPHORIC ACID

Particulars	Mean Yield of Potatoes				G. M.	S. E.	Significant or Not *P = 0·05	C. D.
	OP	1P	3P	5P				
Yield in Pounds per acre ..	9,910	11,390	13,920	14,600	12,455	358·3	Yes	852·3
As percentage on general mean ..	79·5	91·4	111·7	117·1	100	—	—	—
As percentage on control ..	100	114·9	140·5	147·3	—	—	—	—

Conclusions: 5P, 3P, 1P, OP

SECOND YEAR (1950—1951) The yield in the experiment was significant for the main effect of P_2O_5 and its interaction with nitrogen. All other main effects and interactions were not significant.

PHOSPHORIC ACID

Particulars	Mean Yield of Potatoes				G. M.	S. E.	Significant or Not	C. D.
	OP	1P	3P	5P				
Yield in Pounds per acre ..	5,224	7,119	7,784	8,093	6,811	304	Yes	852·3
Percentage on G. M. ..	76·7	104·5	114·3	118·8	100	—	—	—

Conclusions: 5P, 3P, 1P, OP

TABLE II *(Contd.)*

THIRD YEAR (1951—1952) Experiment significant for main effects of nitrogen and phosphoric acid only.

PHOSPHORIC ACID

Particulars	OP	1P	3P	5P	G. M.	S. E.	Significant or Not	C. D.
Yield in pounds per acre	6,982	7,993	8,217	9,181	8,092	275·0	Yes	824·4
Percentage on general mean	86·3	98·8	101·5	113·5	100	—	—	—

Conclusions: 5P, 3P, 1P, OP

NITROGEN

Particulars	1N	N2	G. M.	S. E.	Significant or Not	C. D.
Yield in pounds per acre	7,257	8,928	8,092	184·0	Significant	573·2
Percentage on general mean	89·8	110·4	100	—	—	—

Conclusion: 2N, 1N

TABLE III. Showing the results of soil analysis of the Experimental Plots, Agricultural Research Station, Nanjanad (Nilgiris)

Serial No.	HEADS OF ANALYSIS	Major Plot 1 0—12"	Major Plot 2 0—12"	Major Plot 3 0—12"	Major Plot 4 0—12"
	MECHANICAL COMPOSITION				
1.	Clay	56·82	63·39	59·48	49·52
2.	Silt	17·50	15·70	14·09	16·16
3.	Fine sand	8·97	8·39	8·66	8·18
4.	Coarse sand	16·85	13·59	17·95	24·19
	Total	100·14	101·07	100·18	98·05
	CHEMICAL COMPOSITION				
1.	Loss on ignition	11·70	11·94	13·46	15·78
2.	HCl insolubles	57·85	56·58	55·46	51·76
3.	Al_2O_3	18·50	19·92	19·52	20 65
4.	Fe_2O_3	10·87	10·54	10·43	10·17
5.	CaO	0·135	0·115	0·104	0·104
6.	MgO	0·285	0·388	0·254	0·200
7.	K_2O	0·679	0·706	0·414	0·307
8.	Na_2O	0·253	0·283	0·141	0·204
	Total	100·27	100·47	99·78	99·18
9.	So_3	0·084	0·068	0·067	0·080
10.	P_2O_5 (total)	0·187	0·191	0·196	0·188
11.	Nitrogen	0·177	0·134	0·154	0·203
12.	Available K_2O	0·014	0·008	0·007	0·010
13.	Available P_2O_5	0·008	0·007	0·019	0·017
14.	pH	5·33	4·93	5·80	5·91

TABLE IV. Summary of Results of Post-Harvest Soil Analysis—1949—1950—Surface Soils (percentages)

Treatment Pounds Ingredient per acre			UNLIMED SERIES						LIMED SERIES					
			pH	Nitrogen %	Total P_2O_5 %	Available P_2O_5 %	Lime %	Organic Carbon %	pH	Nitrogen %	Total P_2O_5 %	Available P_2O_5 %	Lime %	Organic Carbon %
N	P_2O_5	K_2O												
40 ÷	0 ÷	100	5·04	0·193	0·185	0·021	0·137	1·81	5·28	0·161	0·176	0·023	0·217	1·91
40	40	100	5·08	0·207	0·171	0·015	0·156	2·00	5·36	0·164	0·182	0·010	0,177	2·13
40	120	100	5·06	0·192	0·173	0·020	0·120	1·88	5·45	0·184	0·197	0·016	0·174	2·27
40	200	100	5·22	0·182	0·272	0·022	0·157	2·24	5·36	0·192	0·208	0·020	0·186	2·14
80	0	100	5·26	0·206	0·267	0·022	0·141	2·26	5·28	0·199	0·184	0·034	0·197	2·63
80	40	100	5·24	0·202	0·243	0·022	0·211	2·50	5·14	0·180	0·202	0·021	0·198	2·30
80	120	100	5·28	0·199	0·191	0·024	0·136	2·27	5·31	0·189	0·194	0·023	0·252	2·29
80	200	100	5·29	0·180	0·168	0·023	0·190	2·22	5·08	0·167	0·193	0·016	0·203	1·74
	Average ..		5 20	0·195	0·221	0·021	0·156	2·00	5·10	0·180	0·192	0·022	0·201	2·10

TABLE V. Summary of results of post harvest soil analysis 1950 — '51 surface soil

Treatment Pounds ingredients per acre			UNLIMED SERIES (Percentages)						LIMED SERIES (Percentages)					
N	÷ P_2O_5	÷ K_2O	pH	Nitrogen	Total P_2O_5	Available P_2O_5	Lime	Organic carbon	pH	Nitrogen	Total P_2O_5	Available P_2O_5	Lime	Organic carbon
40	0	100	4·92	0·173	0·231	0·018	0·154	1·56	5·00	0·154	0·200	0·014	0·201	1·96
40	40	100	5·00	0·168	0·173	0·021	0·163	1·43	5·18	0·170	0·204	0·015	0·196	1·77
40	120	100	5·08	0·151	0·208	0·014	0·137	1·36	5·64	0·160	0·157	0·020	0·193	1·62
40	200	100	5·20	0·141	0·172	0·020	0·181	2·00	5·30	0·135	0·201	0·017	0·157	1·51
80	0	100	5·40	0·160	0·219	0·014	0·187	1·60	4·50	0·150	0·206	0·013	0·196	1·90
80	40	100	5·18	0·165	0·190	0·016	0·200	1·75	5·00	0·128	0·161	0·018	0·187	1·87
80	120	100	4·99	0·159	0·186	0·013	0·152	1·48	5·20	0·160	0·190	0·016	0·198	2·01
80	200	100	5·34	0·164	0·197	0·011	0·142	1·95	5·10	0·161	0·193	0·012	0·200	1·68
	Average		5·15	0·156	0·200	0·016	0·190	1·70	5·11	0·152	0·190	0·016	0.191	1·80

TABLE VI. Showing the results of soil analysis both before and after cropping — average values

Heads of analysis	PRE-CROPPING Available %	PRE-CROPPING Total %	POST HARVEST SAMPLES Lime series Available %	POST HARVEST SAMPLES Lime series Total %	POST HARVEST SAMPLES No lime series Available %	POST HARVEST SAMPLES No lime series Total %
(1) Nitrogen		0·167		0·167		0·180
(2) Phosphoric acid	0·013	0·190	0·019	0·191	0·011	0 210
(3) Lime (Cao)	..	0·114	..	0:196	..	0·173
(4) pH	5·52		5·10		5·18	
(5) Organic carbon		1·77		1·95		1·85

Increase in fertility status after harvest of potatoes.

	Percent
Nitrogen	0·013
Phosphoric acid (available)	0·0064
,, total	0·020
Lime	0·082
Organic carbon	0·18

R. E. Bullock Pump

by

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Centrifugal pumps driven by oil engines and electric motors are undoubtedly about the most efficient means available for lifting water for irrigation and are fast becoming indispensable items in the equipments of most farms. Nevertheless these still remain out of the reach of several thousands of small farmers owning or cultivating only a few acres because their cost in terms of the financial resources of such farmers continues to be prohibitive. Irrespective of whether a farmer employs lift irrigation or not he has to necessarily maintain a few bullocks to do his ploughing and carting. It is seldom if ever that work can be found on a farm for these animals all the year round. Hence if a cheap and fairly efficient water lift which could be operated by a pair of bullock could be devised it was felt that many small farmers would consider its welcome addition to their equipment. It was with the object of providing such a water lift that the design of the bullock pump was undertaken in June '53 at the instance of the Director of Agricultural, Madras. The first successful model of the bullock pump suitable for use in open wells was manufactured and tested successfully at the Central Farm, Agricultural College, Coimbatore towards the end of 1953. In early 1954, a second model of the pump suitable for use in a tube well was also manufactured and tested.

The open well model of the bullock pump consists of two six inch pipes let down vertically into the well and clamped side by side, about 3 ft. apart to a wooden beam placed across the mouth of the well at ground level. The bottom ends of the two pipes extend a few feet below water level, and the top ends project 6′ above ground level. The lengths of these two pipes which form the pump barrels will therefore depend on the depth of water level below ground level. A delivery spout consists of a 3″ dia. pipe welded on to each of the barrels 2′ below the top. A flap valve opening upwards manufactured out of a standard 6″ coupling is fitted at the bottom of each of the two barrels. Two C. I. cylindrical plungers $5\frac{7}{8}$″ in dia., 12″ long with a central bore of $2\frac{1}{8}$″ dia., and each weighing 50 to 60 lb., work inside these pump barrels. The top of the central bore in each plunger is closed with a flap valve opening upwards. A standard leather pump bucket is fitted to the bottom of each

plunger for providing necessary sealing between the plunger and the barrel. The plungers have a stroke of 9′ extending from the water level upwards. The plungers are operated by means of two 3/8″ wire ropes. One end of each of these ropes is attached to a plunger. The ropes are then brought up through the pump barrels and over two pulleys carried on two brackets fixed to the tops of the two barrels.

The wire ropes then diverge horizentally to pass through two pulleys mounted on two posts situated diametrically opposite each other on the edge of a bullock track. The height of the pulleys on the post are so adjusted that the wire ropes are horizontal. After passing through these pulleys the 2 wires are brought together to a common terminal through a swivelling block on a rotating beam at a distance of 4½′ from the centre of rotation.

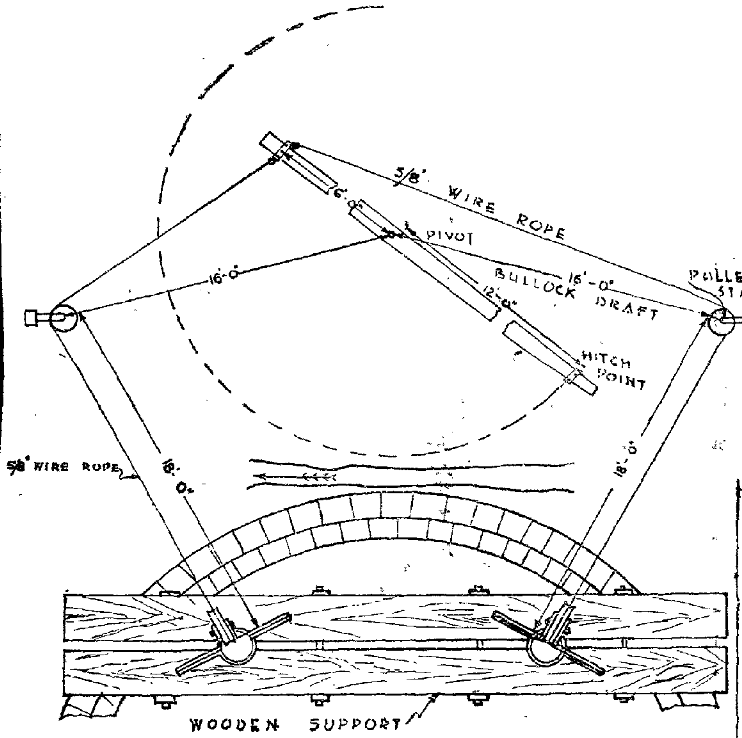
The rotating beam is mounted on a central pivot post fixed rigidly to the ground in a concrete foundation at the centre of the bullock track. A pair of bullocks is hitched to the free end of the rotating beam at a distance of about 12′ from the centre of rotation.

When the bullocks go round the track, the central beam rotates and the plungers move up and down the barrels one plunger ascending and lifting the water while the other descends. Each barrel discharges once during each rotation of the beam. A pair of average bullocks can go round the track at 2½ to 3 times per minute without undue strain.

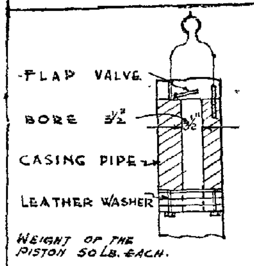
During the preliminary trials conducted with this pump at the Central Farm, Agricultural College, Coimbatore, an output of 2700 gallons per hour against a total head of 20′ was obtained. Under identical conditions the output of double bullock mhote is only, 2000 gallons per hour.

The tube well model of this pump is very similar to the open well model, the points of difference being continued to the pump barrels alone. Each barrel in this case consists of a standard 3″ tube well filter point installed below ground level at a depth where a coarse sand medium bearing sufficient water is available. The filter point is connected to a 3″ pipe which extends up to 9 ft. below ground level. At this level, a check valve manufactured from two standard 3″ couplings welded together is interposed. The pump barrels consisting of a 5″ pipe is screwed on to the top of the check

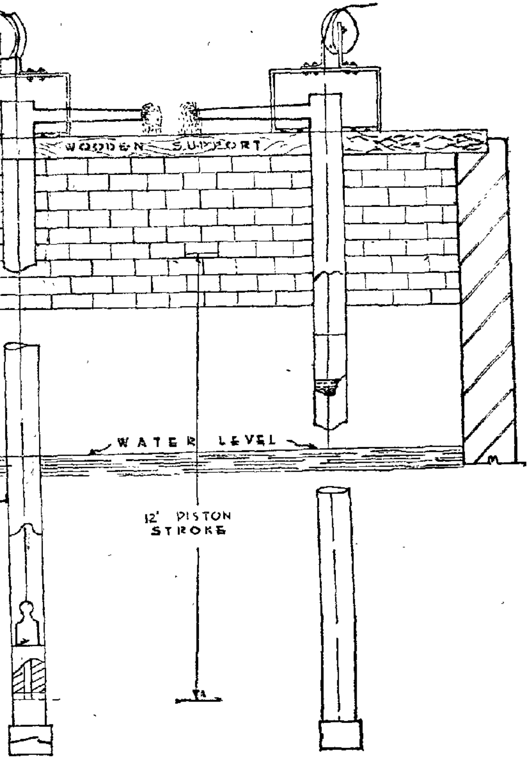
R. E. BULLOCK PUMP
open well model.



plan



CROSS SECTION OF THE PISTON INSIDE CASING PIPE



Elevation.

K.R. Pillai D/M.

T.S. Palanivelu
ASST. AGRL. ENGINEER RESEARCH

valve. The plungers in this case have a stroke of 12 feet extending from the bottom of the barrel upwards. To obtain this stroke the common terminal for the wire rope on the rotating beam is fixed 6 ft. from the centre of rotation. The two pump barrels are spaced about 10 feet apart.

A bullock pump of the tube well model has already been erected at the Agricultural Research Station, Aduthuri in Tanjore district and one of the open well model at the Central Farm, Agricultural College, Coimbatore. Another unit of the open well type is shortly to be erected at the Coconut Research Station, Pilicode in South Kanara district. Drawings and estimates for both the types are given below:

Estimate for the Manufacture of one R. E. Bullock Pump Open-Well model suitable for a total lift of 20'

S. No.	Particulars of Materials	Quantity	Rate Unit	Amount
			Rs. A. P.	Rs. A. P.
1	6" W. I. Pipes ..	50'	5 0 0 per ft.	250 0 0
2	2" W. I. ,, ..	6'	1 2 0 ,,	6 12 0
3	2" W. I. Coupling ..	2 Nos.	1 0 0 each	2 0 0
4	6" W. I. Coupling ..	4 ,,	10 0 0 ,,	40 0 0
5	C. I. Plungers (Rough Casting) ..	2 ,,	26 0 0 ,,	52 0 0
6	2" × 2" M. S. Bar for Central Pivot ..	5'	1 8 0 per ft.	7 8 0
7	4" Pulley with sleeve ..	2 Nos.	7 0 0 each	14 0 0
8	8" Pulley with ball bearings ..	2 Nos.	15 0 0 ,,	30 0 0
9	1" × 1" M. S. Bar for pulley frame ..	20'	0 12 0 per ft.	15 0 0
10	2" × ½" M. S. Flats for swivelling block ..	2'	1 0 0 ,,	2 0 0
11	5/8" M. S. rod ..	12'	0 3 0 per ft.	2 4 0
12	3/8" Wire rope ..	80'	0 6 0 ,,	30 0 0
13	T. W. Beam for supporting pump barrels 16' × 8" × 4" ..	2 Nos.	15 0 0 each	30 0 0
14	Wooden posts 8' long ..	2 Nos.	5 0 0 each	10 0 0
15	T. W. Poles 18' long for rotating beam ..	1 No.	15 0 0 each	15 0 0
16	Bolts and nuts, leather for flap valves, concrete for foundation etc. ..			35 0 0
17	Labour charges ..			100 0 0
18	Contingencies ..			33 8 0
				675 0 0

Estimate for Manufacture of 1 R. E. Bullock Pump—Tube Well—Model Suitable for a Total Lift of 20′

S. No.	Particulars of Materials	Quantity	Rate Unit	Amount
			Rs. A. P.	Rs. A. P.
1	3″ Tube well filter points ..	2 Nos.	115 0 0 each	230 0 0
2	3″ W. I. Pipes ..	15′	2 8 0 per ft.	37 8 0
3	3″ W. I. Coupling ..	8 Nos.	1 12 0 each	14 0 0
4	5″ W. I. Pipes ..	28 Nos.	4 12 0 per ft.	133 0 0
5	3″ W. I. Bends ..	2 Nos.	12 0 0 each	24 0 0
6	C. I. Plungers (Rough costing) ..	2 Nos.	26 0 0 each	52 0 0
7	2″ × 2″ M. S. Bar for Central Pivot ..	5′	1 8 0 per ft.	7 8 0
8	4″ Pulley with sheave ..	2 Nos.	7 0 0 each	14 0 0
9	4″ Pulley with ball bearing ..	2 Nos.	15 0 0 each	30 0 0
10	1″ × 1″ M. S. Bar for pulley frame ..	20′	0 12 0 per ft.	15 0 0
11	2″ × ½ M. S. Flat for swivelling block ..	2′	1 0 0 per ft.	2 0 0
12	⅝″ M. S. Rod ..	12′	0 3 0 per ft.	2 4 0
13	⅜″ Wire rope ..	80′	0 6 0 per ft.	30 0 0
14	Wooden posts 8′ long ..	2 Nos.	5 0 0 each	10 0 0
15	T. W. Poles 13′ long for rotating beam ..	1 No.	15 0 0 each	15 0 0
16	Bolts and nuts, leather for flap valves, concrete for foundation			35 0 0
17	Labour charges ..			10 0 0
18	Contingencies ..			23 12 0
				775 0 0

ON LORD RUTHERFORD

"He broke the indivisible
Made plain the invisible
Changed the immutable
And unscrewed the inscrutable"

(Stephen Miall)

Studies on the Influence of the time of Planting and Mulching on the Yield of Potato

by

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Introduction: There are three well-defined seasons for the potato crop on the Nilgiris, of which the main and the second crops occupy nearly 18,500 acres out of the average of 20,000 acres of the total area. The main crop, which is extensively cultivated, is planted in March-April and harvested in August-September. The second crop is raised between August and December. Both these crops are purely rain-fed and cover about 11,500 and 7,000 acres respectively.

The average annual rainfall is about 55 inches, half of which is received during the South-west monsoon rains, which is the period for the growth and maturity of the main crop. The remaining rainfall is received as equal halves, in the North-east monsoon when the second crop is on the field, and as summer rains which are usually accompanied by hail. Both the high winds and the hail-storms are harmful to the two crops, as they damage the haulms of the potato with consequent reduction of yields. Thus, the correct time of planting both the crops assumes great significance, if optimum yields are to be secured against the above adverse factors of seasons and rainfall. In addition, the second crop has to contend against the heavy ground-frost which usually sets in during the middle of December and continues up to the end of February. It is not uncommon if frost appears early in November and continues, in some years, till the end of March or even into April. In such extreme cases, the succulent potato haulms are cut down with heavy loss of yiels.

Trials were undertaken at the Agricultural Research Station, Nanjanad, during the three years 1949. 1950 and 1951, to fix the best time of planting the main and the second crops to secure optimum yields, and the results obained are presented in Section I of this paper. The crop is mainly grown over steep slopes. Hence during particularly heavy downpours, much of the valuable top-soil, with a good quantity of the fertilisers applied, is washed down. It is because of this that the ryots are forced to liberally manure the crop every year, the expenses on this account alone amounting to over Rs. 300/- per acre. The beating effects of the rains do not end with the losses of soil and fertility, but the developing top-tubers are also liable to be exposed to attacks by the tuber moth. Under such conditions, the

damage to the exposed tubers by pests like rabbits, rats, porcupines and wild bears may also prove severe. Due to such exposure the tubers tend to get hard and green before full maturity, resulting in a fall of their market value.

As a consequence of the rich manures applied, the common weeds in the region like spurry, oxalis, and polygonum also grow rank and use up the bulk of the plant food given for the crop. Labour is generally scare and the incessant rains miliatate against timely weeding of the land. Therefore, any step that would prevent the soil wash and, at the same time, keep the weeds in check, would prove a valuable aid to the farmer in considerably reducing his costs of cultivation and possibly increase his yields. To meet this object, trials were started att he Agricultural Research Station, Nanjanad, to study the effects of mulching the potato crop with dried vegetable refuse like the straw of *Samai (Panicum miliare)*, the cereal which is usually grown in rotation with potato. The results of such a mulching practice, which proved distinctly benefical, are recorded in Section II of this paper.

I. TIME OF PLANTING

Innes and Mac Dermott (1), investigating the loss due to late planting with the variety, *Majestic*, confirmed that delayed planting seriously reduced yields. Harvey (2) indicated that varietal characters had an important bearing on the time of planting, though the variety, *Arran Banner*, did not suffer the loss to the same extent as the variety, *Majestic*. Thomas and Eyre (3) recorded that the condition of the land and locality influenced the time of planting of early potatoes.

The popular early variety of potato, *Great Scot*, was used for the above trials. Four instalments of planting, spaced at fortnightly intervals, were adopted for the two crops af follows:

Treatment		*Main crop*	*Second crop*
A	(Standard)	Planted on 15th of March	Planted on 1st of March
B	,,	,, 31st ,,	,, 15th ,,
C	,,	,, 15th of April	,, 1st of Sept.
D	,,	,, 30th ,,	,, 15th ,,

Each treatment was replicated six times. The cultivation and manuring followed were in conformity with the routine practices adopted at the Station. The earliest planted treatment (A) was taken as the standard for assay of yield data.

The summary of results of the trials, seperately for the main and the second crops, is presented in tables I and II.

TABLE I. Summary of resnlts — (Main crop)

	Treatments				General Mean	Standard Error
	A (Std)	B	C	D		
(1949)						
Acre yield in lb.	11528	10904	11540	10652	11156	1136
Percentage on standard	100·0	94·5	100·1	92·3	96·7	4·9
(1950)						
Acre yield in lb.	9880	10120	13160	10480	10910	894
Percentage on standard	100·0	102·4	133·2	106·1	110·4	9·1
(1951)						
Acre yield in lb.	16440	16260	22120	17090	17983	480
Percentage on standard	100·0	99·0	134·5	103·9	109·3	2·9

Conclusions: (1949): No significant differences; (1950): C, D, B, A;
(1951): C, D, A. B.

TABLE II. Summary of results — (Second crop)

	Treatments				General Mean	Standard Error
	A (Std)	B	C	D		
(1949)						
Acre yield in lb.	4316	2892	2268	1736	2803	752
Percentage on standard	100·0	67·1	52·5	40·2	64·9	8·7
(1950)						
Acre yield in lb.	4600	3960	2960	3840	3840	346
Percentage on standard	100·0	86·1	64·3	83·5	83·5	7·5
(1951)						
Acre yield in lb.	11840	7280	7520	6240	8220	564
Percentage on standard	100·0	61·5	63·5	52·7	69·4	4·8

Conclusion: (1949): A, B, C, D; (1950: A, B, D, C; (1951): A, C, B, D.

Discussion of Results: The results of all the three years, for both the crops, followed a like pattern. Taking the main crop into consideration, the treatment planted in the middle of April (C) had consistently returned the highest yields for each of the three years of trial. Further, the yield from this treatment was significantly higher than those of the other three for the two years 1950 and 1951. In the case of the second crop, a similar behaviour in favour of highest yields was evident and consistent for the treatment planted at the beginning of August (A), this treatment being significant over the rest in 1951.

II. MULCHING

Information on the subject of mulching the potato crop is limited. It has been recorded by Terman, Libby and Jenkins (6) that a light mulching of the land, after the potatoes are planted, helps to maintain the organic matter added thereby to the soil, making it better. The mulching materials used were partly retted straw, unchopped green grass and clover, and these were applied after the potatoes had been ridged once. Such a practice was observed to increase the yield considerably, while mulching with sawdust tended to lower yield values. Application of an extra dose of nitrogen, at the rate of 60 lb. per acre, further increased the yield of potatoes mulched with grass, but not those mulched with clover. Studying the effect of application of sawdust on the production of fall potatoes for improvement of the texture and water retention of soils, Johnson (4) found that the treatment tended to depress the soil nitrates due to their increased assimilation by bacteria using the sawdust as a source of energy, and concluded that the supply of nitrogen should therefore be increased if sawdust is applied. The use of trash and vegetable debris left on the soil surface, where they can act as a hindrance to evaporation has been mentioned by Keen (5) in the booklet, "Food and the People", published by the Bureau of Current Affairs, London.

The trials under report were conducted over three different crop seasons, viz., the second potato crops of the years 1950 and 1951, and the irrigated crop of 1951. Uniformly graded whole seed tubers of the popular variety, *Great Scot*, were used for the investigations. Cattle threshed dry *Samai* straw and chopped and dried stems of *Juncus glaucus* formed the mulching material. The experimental plots were laid out in randomised blocks, replicated six times. Five treatments were adopted as given below :

A	Control (Unmulched)		
B	Mulched at	1,250 lb.	of vegetable debris per acre.
C	,,	5,000 lb.	,, ,, ,,
D	,,	8,000 lb.	,, ,, ,,
E	,,	10,000 lb.	,, ,, ,,

The mulch material was carefully weighed to conform to the above dosages, and spread out evenly over the related treatments, after planting the potato seed. The yield data for the three seasons, with statistical examination of the results, are summarised in table III.

Section II: MULCHING

TABLE. Summary of Results

Season and Crop	TREATMENTS					General Mean	Standard Error	Mulch Material	Remarks
	(A)	(B)	(C)	(D)	(E)				
Second Crop (1950)									
Acre yield in lb. ..	5,655	4,150	5,100	5,525	5,525	5,245	376	Dry *Samai* straw	Crop cut down by early frost
Percentage on Control (A) ..	100·0	73·7	90·6	103·5	98·2	93·2	3·34	—	—
Second Crop (1951)									
Acre yield in lb. ..	3,400	3,900	5,500	7,850	8,200	5,770	980	Dry stems of *Juncus glaucus*	—
Percentage on Control (A) ..	100·0	100·0	161·7	230 8	241·1	169·6	28·8	—	—
Irrigated Crop (1951)									
Acre yield in lb. ..	4,700	4,900	4,400	6,150	7,200	5,410	82	Dry *Samai* straw	—
Percentage on Control (A) ..	100·0	104·3	93·6	130·8	153·2	116·4	1·7	—	—

Conclusion: Second crop (1950): D, A, E, C, B; Second crop (1951): E, D, C, B, A; Irrigated crop (1951): E, D, B, A, C.

Discussion of Results: Out of the three crops taken up for the trials, the second crop of 1950 could not grow up to normal maturity, since it was subject to premature damage due to early frost. The other two crops completed their growth and came to lifting under normal seasonal conditions.

As examination of the yield data leads to the conclusion that mulching is conducive to higher potato yields. For instance, in the second crop (1951), the treatments that received mulch at 8,000 and 10,000 lb. per acre, significantly out-yielded the other three treatments including the control while, in the irrigated crop (1951), there were significant yield differences between each and every one of the treatments, the order of superiority being as follows: 10,000 lb., 8,000 lb. and 1,250 lb. of mulch, control and 5,000 lb. of mulch. For the second crop (1950), all the four treatments including the control were significant over the treatment with 1,250 lb. of mulch (B) but, as already stated, the crop was laid low due to severe ground frost before maturity, thus vitiating the yield values. Leaving this crop out of account, the results of the other two have yielded indications in favour of dressing the soil heavily with 8,000 to 10,000 lb. of mulch.

Another point that was evident was that mulching resulted in considerably cutting down the cultivation expenses by saving a course of weeding. Field observations showed that while the weed growth and population were very little or negligible in the mulched treatments, the control plots had to be given a hand-weeding, Normally, a round of weeding takes 50 to 60 women in these parts since, with weeding, the crop has to be carefully, earthed up. Disturbing the soil immediately beneath the plant may, again, tend to injure the stolons that would later develop tubers.

Samai is the main cereal grown in the tract. Since grazing is available in plenty, the cultivators are not very keen on storing the straw for cattle feed, The high cost of transport in the hilly tract is another factor. Hence, the normal practice is to burn the cattle-threshed straw, along with the stubbles left on the field, just before the land is opend for the following potato crop. Thus, this material is available for mulching the potato in abnndance. Even in the absence of this material, any dried vegetable debris may be used.

The benefits of mulching are manifold. The plant residue added to the soils, which are porous and deficient in humus, builds up the organic food reserve of the land thereby enriching it. Its effect on the check of weeds has already been mentioned. Mulching

helps the retention of moisture during the dry whether period (January — April), when the irrigated potatoes are on the field, leading to a reduction in the frequency of watering. During the heavy monsoon periods over which the main and the second potato crops are raised, the mulch protects the top-soil from the beating effects of the downpour, preventing wash-down of the soil and the manure from the land. When showers are so heavy as to lead to sheet or rill erosion, mulching will protect the exposure of the developing tubers nearer the soil surface to the elements and pests. The trials reported are being modified, in view of the results already obtained, to include quantitative studies on the relative moisture-holding capacities of the different treatments, weed population and degrees of severity of incidence of pests like the cut worm and the tuber moth.

Summary and Conclusion: From a review of the yield figures obtained, it is concluded that, to secure optimum yields under Nilgiri conditions, the main and the second crops of potato are best planted respectively by the middle of April and early in August.

Preliminary trials on the results of mulching the land under the potato crop with vegetable debris, at the Agricultural Research Station, Nanjanad, have indicated that such a practice is beneficial for increasing the yield of the crop; besides it acts as an effective check on weed growth and against soil erosion. Further studies on its value in conserving soil moisture and other points are in progress.

Acknowledgment: The authors recorded their gratefulness to P. Uthaman, K. Hanumantha Rao and P. N. Nayar, who were the Superintendents of the Station during the period, for their valuable guidance, direction and help in the conduct of the trials.

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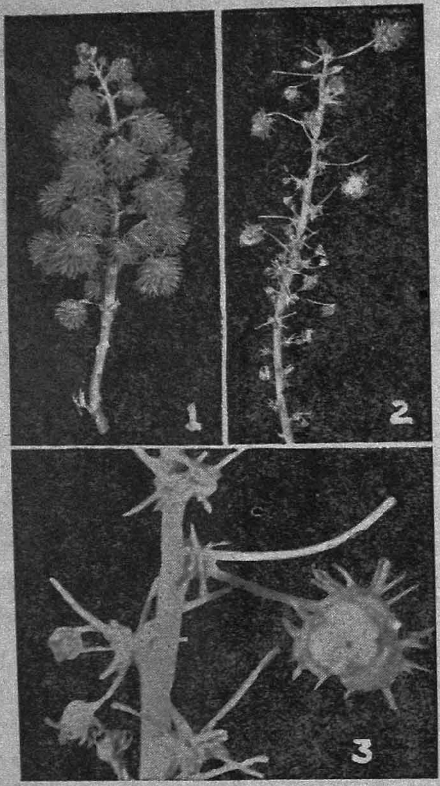
A Note on an Abnormality in the Fruits of Castor (*Ricinus communis*, L)

The species *Ricinus communis*, L. is characterised by the ovary being three carpelled and each carpel containing a single ovule. The fruit is a schizocarp of three cocci and each coccus has a single seed. The capsule is partially dehiscent. In one of the cultures, i. e. R. C. 1080, a number of plants with one to two ovules in a single carpel was noted, during 1953 – '54 rainfed season at the Agricultural Research Station, Tindivanam. Observation on this abnormal type of castor is recorded here. As far as the authors are aware, no record of such occurence has been made so far. In one of the lines of the 12th generation progenies of a cross between R. C. 961 (Namakkal – irrigated) and R. C. 816 (Kumbakonum) grown under rainfed conditions, a number of plants with poor fruit-set was noted. On closer examination these were found to have abnormal capsules with more than one ovule in one coccus. It was noted that these plants showed heavy shedding of the female flowers and only a few that remained developed into fruits. These abnormal fruits as they develop showed slight splitting of the carpellary wall towards the top exposing the developing seeds in the cocci in which there is more than one seed. Generally only one of the cocci show the double seeded condition and rarely two cocci have two seeds in each making up a total of four or five seeds in the schizocarp instead of the normal three noted in the species. The two seeds occurring in a single carpel are placed one over the other. Development of size is poor in them but the seeds are properly formed and are viable. The placentation of the ovules is, however, axillary and therefore normal. Due to the increase in number of ovules in one of the carpels the splitting of the pericarp takes place quite early in the development of the fruit. The occurrence of two ovuled carpels has been calculated to be about 2% of the population in the 12th generation of the cross. The tribe *Crotoneae* under which *Ricinus communis* is placed is characterised



by the single ovuled condition in each carpel. Under *Euphorbiaceae* the genera coming under the tribes *Buxeae* and *Phyllanthae* only have two ovules in each cell. The occurrence of two ovuled carpels in *Ricinus communis* shows the possibility of a genetical aberration. The type is under further study.

Acknowledgements are due to Sri D. Daniel Sundararaj, Lecturer in Botany, Coimbatore for his help in preparing the note.

Agricultural Research Station, Tindivanam.

BHAVANI SHANKER RAO, M.
THANDAVARAYAN, K.

A Note on Crabs (Paratelphusa hydrodromus. H) in Paddy Fields — Control with Warfarin Baits

During the course of poison baiting trials with 'Warfarin' at 0·025% in popped rice with fried onion and fish bits as attractants against field rats, it was found that crabs (*Paratelphusa hydrodromus.* H) in the experimental area of four acres under 'Samba' crop, were freely feeding on the Warfarin baits and a total of 113 dead crabs were collected. Apart from this, some more might have died within the burrows and a few other dead ones might have been carried away by brids etc. This heavy casuality of crabs noticed in the experimental area suggested the possibility of using 'Warfarin' baits for the destruction of the crabs in the paddy fields.

Trials were accordingly carried out to test the efficacy of the poison bait when fed to crabs of similar size and appearances for different periods ranging from 1 to 4 days and changing to normal food thereafter. The survival of the crabs in the different sets was compared with the control set of crabs of similar size and number with unpoisoned food. The condition of the crabs in the different treatments was also noted. The results of the various treatments are given in table below:

Statement showing the duration of survival of crabs with poisoned baits

TREATMENTS	Duration of survival of crabs		
	I set commenced on 28—1—1953	II set commenced on 16—1—1953	III set commenced on 2—2—1953
Popped rice and fried onions and fish bits with 0·025% Warfarin for 1 day	7 days	8 days	9 days
,, ,, for 2 days	5 ,,	6 ,,	7 ,,
,, ,, for 3 days	2 ,,	4 ,,	5 ,,
,, ,, for 4 days	2 ,,	2 ,,	4 ,,

With control sets of crabs fed with unpoisoned food viz., popped rice, fried onions and fish bits and with natural food viz., young paddy plant and bits of fish, no casualities were noticed and they were found healthy. The data reveal that the shortest period of morality is in the case of crabs fed with poison baits continuously for four days and changed over to normal diet thereafter. This period of survival varies from 2 to 4 days for crabs fed with poison baits for 4 days continuously and 7 to 9 days for crabs fed with poison baits for a day only. No distinct advantage was noticed when the base in the poison bait was changed from popped rice to fried or raw rice bran as advocated by Venkataraman (1929).

Field trials with 'Warfarin' baits at Agricultural Research Station, Aduthurai, from September '52 to February '53 in paddy areas have been found very effective in controlling the crab menace. The use of 'Warfarin' baits for control of field crabs deserves to be popularised in areas where trouble due to crabs are encountered. The baits can be conveniently kept in coconut shell at places frequented by crabs. The baiting should be continued for atleast a week in the field with the addition of 2% Nitrophenol to prevent the development of moulds in the baits. In the experiments conducted Dethmor containing 0·5% 'Warfarin' available with Messrs. Standard Chemical and Pharmaceutical Company, Bombay, was used The cost of baiting with 'Warfarin' works out as Rs. 8/- per acre. With increase in the demand for 'Warfarin', its price is likely to go down appreciably. Dropping into crab holes a pellet of the poisoned food of the size of a pigeons' egg can also be undertaken if crab holes are not too many as this seems to be the best method of baiting according to Rao and Susaynathan (1923).

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TIRUMALA RAO, V.
SANTHANARAMAN, T.

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A Preliminary study on the distinctiveness of Dormancy and Viability in vegetable seeds

In the interests of the survival of the species, delay in germination or dormancy of seed is of great value to the plant. Dormancy, as defined by William Crocker, a pioneer worker in seed research, is a '*general term*' which may be applied to any condition which prevents

germination, when ordinary requirements of moisture and temperature have been met. Barton Lela, as cited by William Crocker, finds that under natural conditions in the soil while some of the seeds of *Amaranthus reoflexus* (a weed) germinate in less than ten months, others remain viable without germinating, even though they would have absorbed water. It is to be noted that when a seed germinates in a soil after such a long period as ten months it cannot be due to obtaining of a particular condition of temperature; for the soil temperature varies, while the requirements may already be there. So, if the above definition of dormancy is correct and the time taken must essentially be due to the process of softening of the outer coats of the seed. Attempts to scarify or soften the seed coats by different treatments to fecilitate successful germination are often called as 'breaking up dormancy'. But it may not be correct to say so if it is understood, that dormancy and viability go hand in hand while dormancy is the means and viability is the end. Dormancy covers a period of conception when the germ-plasm of the seed developes to become viable and until then it is incapable of germinating, in this light, it is reasonable to accept the finding of Thornton Norwood that lettuse seeds were dormant when freshly harvested and after ripen in dry storage. So dormancy should not be considered as a '*general term*' for a scientific study; for it refers specifically to the latency of life in the seed before it could germinate. Some ordinary observations should be able to bring out this distinctiveness and this report embodies the result of such an attempt.

Seeds of tomato, amaranthus, cowpea, bitter gourd, okra and snake gourd were selected to represent types of seeds for the study. Seeds of the first three kinds were tested on germination trays on moist filter paper and the rest on the medium of moist sand. Germination counts were taken on the emergence of the hypocotyl in the case of filter paper medium and on the appearance of green shoot at surface in the other case. Seeds for the tests were extracted from fully ripe fruits on 30—10—1950 and dried in the sun for 3 days before commencing the tests. The actual tests started on 3—11—1950 in duplicate. The counts were taken from the next day and continued for ten days. The test was repeated at fortnightly intervals till 18—4—1951. With the exception of bitter gourd all other seeds do not show any dormancy at the beginning as they start with full germination capacity even on the first week. Upto the second fortnight, there is only rise and no fall in germination percentage. In the subsequent two fortnights, however, there appears to be a slight decline in germination capacity. From the sixth fortnight onwards the germination percentage tends again to increase.

To investigate whether frequent dryings affect the dormancy of these seeds, representative samples of each seed were made up into duplicate sets. One such sample was dried for one day before every

germination test, while the other was stored away after the initial drying alone. It became clear from germination counts taken systematically that frequent dryings have no effect on retarding the dormancy of these seeds.

From the tests it became clear that so far as some vegetable seeds are concerned, it seems as though there is no dormant period for them at the beginning during the first week after their extraction. This is almost viviparous tendency. Following this the rapid ascent of the percentage in the second week itself becomes a complement; that there is decline thereafter is an indication that the seeds enter a dormant life and that the percentage of germination does not improve even after 3 months is a casual indication that only certain seeds set out of the latency of life in that period and the rest remain dormant for a further period with due regard to the finding of Barton Lela.

Thus the vegetable seeds in the test, in spite of the varying nature of their seed coats, do not show dormancy soon after harvest. There was a decline in the germination percentage during the second month, but it was not the result of loss of viability, as the figures again improve after the period.

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SHANMUGAM, T. S.

"Twenty years of Seed Research" — William Crocker; "Dormancy in Wheat and Barley varieties in relation to breeding" — J. B. Harrington and P. F. Knowles - 5 Agri. Vol. 20, 1939 - '40.

The Atoms in turn, we now clearly discern
Fly to bits with the utmost facility
They wend their way
And in splitting, display
An absolute lack of stability.

(Stephen Miall).

CORRESPONDENCE

From

A. P. KRISHNASWAMI NAIDU,
Avarampalayam, Ganapathi Post,
Coimbatore, 16—6—1954.

Sir,

In sowing, the country drill, Gorru, leaves the seed at an ill-fitting spot 1½ to 2½ inches below the surface. The proper seed depth advised seems to be half an inch. This in practice is hard to achieve with the Gorru as it is now. The angle between the tyne and the shaft being 45 degrees the furrow is made a little too deep, up to 2½ inches. A shallower furrow is impracticable with this plough. In this connection I like to suggest a slight change in the angle of the tyne and the pole by fitting it at 30 or 36 degrees; and request the Research Engineer for advice in this matter, and to make a trial of the suggestion if feasible.

As an alternative to the above change, I think that the shaft can be so adjusted to the beam of the plough that the angle of draught can be varied at will by some simple mechanism.

Yours cordially,
A. P. KRISHNASWAMI.

* * * *

Office of the Asst. Agrl. Engineer (Research),
Lawley Road P. O., dated 26—6—1954.

Sir,

I acknowledge receipt of your letter dated 16—6—1954. The Millet Specialist and the Cotton Specialist were consulted regarding the advisability of sowing seeds at as shallow a depth as ½ an inch.

The Millet Specialist is of opinion that the optimum depth for sowing millet seeds is about 2″. Seeds sown at a shallow depth develop a very shallow root system which increases the tendency of the plant to lodge. If seeds are sown at a depth of ½ an inch the moisture available may not be sufficient for the seeds to germinate unless a few light showers are received, after the sowing. Further in case very heavy showers are received the seeds are liable to be exposed and carried away by ants and birds A shallow root system also limits the area from which the plant is able to absorb nutrients.

In case of cotton, drill sowing is usually adopted, only where the crop is raised on the rainfed conditions. Sown at a depth of ½ an inch enough moisture may not be available for the germination of seeds unless light showers are received after the sowing, Hence the depth of sowing recommended in the case of cotton is 1″.

A fairly wide range of depth of sowing can be obtained in a country gorru by hitching the bullock either nearer to or farther away from the implement and also by attaching the shaft pole either below or above the yoke. In case of wider range desired it is possible purely from an engineering point of view to alter the angle between the shaft pole and the tynes from 45 to 30°.

Asst. Agrl. Engineer (Res.)

Note on Rayungan in Sugarcane Cultivation: Rayungan is sprouted bud on Sugarcane and it is considered fit for planting when about 6 – 8 weeks old. Younger Rayungans are inferior, to stout and aged ones in the matter of establishment in the field. However experience showed that Rayungans are in no way better than setts. In the trials conducted on Sugarcane Research Station, Gudiattam, from 1951 — '52 to this date, it has been observed that setts sprout and come up better than the Rayungans from the very beginning of the growth. The percentage of establishment of Rayungans depends on the age, size and the after care taken for establishment of the same. In Rayungans more than 90% establishment is considered satisfactory, but this is found to be difficult of achievement of local conditions.

From the date of planting Rayungans need a fairly moist condition of the soil for better establishment failing which the establishment is very low. The only advantage in Rayungans is, it affords quick multiplication and hence when this is combined with short cropping in factory areas, when new varieties are required to be multiplied and spread to a large extent, the method would be most suitable. Rayungans are obtainable in instalments as only the top buds yield good sized Rayungans after 6 weeks and the bottom ones takes some more time to develop to the required size. As such planting has to be done in instalments and not in one instalment as in the case of setts. It is generally believed that there is saving in cane by planting Rayungans as against setts, where as the observations do not confirm the same. The experiments conducted show that planting Rayungans or setts with 12" spacing in the furrows taken 5 links apart is the optimum and as per this spacing the seed rate works out to 13,000 to 14,000 Rayungans per acre. To obtain 13 – 14 thousand Rayungans it may be necessary to cut canes with atleast 18,000 buds to allow for rejections, as is very common in Rayungans. Only best and well grown Rayungans are taken and the rest rejected and hence the need for the above number to be cut. The topped canes may be planted as either Tjeblokam or crushed. But they are poor in quality and they cannot give good quality jaggery, nor can they be supplied to factory as millable cane. (Tjeblokans are the top halving). Of the canes cut for producing Rayungans and these when planted strike roots and give Rayungans otherwise known as Tjeblokans. In view of their lack of root system at planting they take longer time than topped canes to give required size Rayungans.

As regards population of cane it is generally better in Rayungan than in setts this would be evident from the data of the year 1953 — '54 given below:

Population per acre

Spacing with row	Co. 419 setts (3 buded)	Co. 419 Rayungans	Co. 449 setts (3 buded)	Co. 449 Rayungans
6"	38,520	39,780	40,830	36,080
12"	35,260	31,030	35,260	33,340
18"	26,970	31,260	27,640	32,900

The yield data of 1953 — '54 trial is as follows:

Spacing	Co. 419 setts (Tons/Acre)	Rayungan (Tons/Acre)	Co. 449 setts (Tons/Acre)	Co. 449 Rayungan (Tons/Acre)
6″	47·66	45·54	42·99	42·40
12″	52·93	48·97	44·68	45·71
18″	38 90	47·23	34 02	46 92

The Rayungans have yielded better than setts only in plots planted with 18″ spacing and in other treatments the difference in yield is not marked. However to arrive at definite, conclusions replicated randomised trial has been laid in the current year

2. **"Oil Content and Economic Value of Eucalyptus species".** The history of Eucalyptus on the Nilgiris dates back to the year 1845, when it was first introduced by the early settlers mainly as an experimental measure in their hunt for some trees which will yield them abundant supply of fuel. Encouraged by the intital success of this venture, large-scale planting of Eucalyptus, mainly the species *Eucalyptus globutus,* commonly called 'Blue-gum' commenced in the year 1850 and within a few decades large plantations of 'blue gum' flourished in these hills. It is now a common sight to find hill slopes in the various parts of Nilgiris clothed with blue gum plantations.

The genus Eucalyptus consists of more than 200 species, all being natives of Austrialia. Of these, only 35 species have been tried on these hills and specimens of these, most of them 50—60 years old, can be found even now at the Government Botanic Gardens, Ootacamund and Sim's Park, Coonoor. These vary in their economic importance, either as yielders of oils of medicinal or of perfumery value or useful for fuel or timber. Of the 35 species, *Eucalyptus globlus* alone has been exploited commercially to the full. The value of the other species as oil-yielders has not been gauged. This is chiefly because of the high medicinal value of the blue gum oil which is employed in the cure of malaria. The relative immunity of Australia from malaria is said to be due to its large Eucalyptus plantations. Hence the genus Eucalyptus deserves to be studied in greater detail of the various species, particularly from the point of view of their oil content.

Though it is well known that the oil of Eucalyptus is extracted from the 'blue gum' few people are aware that other species as well are capable of yielding oil of equal value. To study the oil content of the various other species, trial distillations were carried out at the Government Botanic Gardens, Ootacamund, for the last 2 years in a rather rough way. The results are tabulated below:

(1)	Eucalyptus	anygdalica	0·69	(15)	Eucalyptus	marginata	0·47
(2)	,,	botryoides	0 03	(16)	,,	melliodora	0·45
(3)	,,	citriodora	0·46	(17)	,,	pullularis	0·47
(4)	,,	crebra	0·22	(18)	,,	piperita	0·34
(5)	,,	deanii	0 42	(19)	,,	punctata	0 32
(6)	,,	dives	0·30	(20)	,,	regnanus	0·32
(7)	,,	eugenoides	0·25	(21)	,,	resinifera	0·25
(8)	,,	ficifolia	—	(22)	,,	redunica	0·45
(9)	,,	globulus	0·55	(23)	,,	robusta	0·02
(10)	,,	gemiphoia	0·21	(24)	,,	saligna	0·08
(11)	,,	longifolia	0·40	(25)	,,	smithii	0·30
(12)	,,	macrocornys	0·28	(26)	,,	teretocornys	0·63
(13)	,,	maculata	0·21	(27)	,,	viminalis	0·30
(14)	,,	macrandra	0·34				

The percentage of oil noted could be considered only rough indications of the value of the species at this elevation. The distillations were carried out in a 'still' which is likely to be only half as efficient as if done on a strict laboratory scale or under ideal conditions. The oil content, moreover, is governed by such other factors such as climate, season, soil conditions and different stages of the plant, age of leaves etc. Difference in the oil content between individual trees of the same species is also not uncommon. Thus for example, the percentage recorded for *Eucalyptus anygdalina* is 3%, though it was possible to get only 0·69% with the available apparatus and facilities. With improvement in the distillation 'still' and under ideal conditions, it should not be difficult to obtain higher recoveries of oil from the various species at this elevation.

Next to 'blue gum' which is most commonly used in the extruction of oil, *Eucalyptus citriodora* ranks second in importance with its highly cented oil. The oil contains a large percentage of 'citral' a base for perfumes, and because of this, oil of Citriodora is highly valued and is chiefly in demand from the perfumery industry, mainly for soaps. This species is therefore coming into prominence of late.

3. **Sugarcane Introduction of Promising now Varieties Co. 467 in the Pugalur Sugar Factory Zone:** In the Pugalur Sugar Factory Zone the variety Co. 419 is being grown practically over the entire area. Ratooning for two seasons is an established practice in all centres supplying canes to the factory. But this variety is very susceptible to smut disease. The necessity to find suitable alternate varieties became very urgent.

Co. 419 variety gives to the grower good tonnage. So any alternate variety acceptable to the growers should be definitely more promising than Co. 419. In the factory area encouragement will be given only to varieties that can give a higher recovery. The variety Co. 467 is therefore found most suitable for multiplication and further large scale trials under ryots conditions and has therefore been released for these purposes for the first time this season. The ryots are willing to grow this cane and the factory management also are agreeable to its release for trials.

The following are important features to justify the spreading of this variety for further large scale trials.

(1) The field of Millable cane is always more than in Co. 449 variety for all seasons of planting. (2) Its juice quality is not inferior to Co. 419. (3) It is a completely non-flowering type (4) It is fairly resistent to smut. (5) It tillers profusely and is eminently suited for ratooning. (6) Its juice quality does not deteriorate even by 12 to 13 months of age of crop and is therefore very ideal for late season crushing. (Director of Agriculture, Madras).

The Genetics of Jassid Resistance in Cotton-I. The Genes H_1 and H2 by R. L. Knight J. Genet. 50, 1952—47—66. (Ministry of Agriculture, Sudan Government, Mem. Res. Divsn. No. 27, 1952.)

Serious damage to Sakel variety of cotton *(Gossypium barbadense* L*)* by Jassids *(Empoasca libyca)* is caused in the Sudan Gezira, in irrigated tract between the Blue Nile and the White Nile. The present paper deals with the study of inheritance of leaf hairiness in cotton and the position of main hairiness genes H_1 and H_2 is discussed and in a subsequent paper it is proposed to be shown how a high degree of jassid resistance can be built up by adding to H_1 a limited number of minor genes. The final objective is the synthesis of jassid immunity in Domains Sakel. It is known that resistance to jassid *(E. facilis)* depends on the presence of hairs of adequate length and density on the underside of the leaves and observations showed that this relationship holds good for *E. libyca* also. Hence the study of the inheritance of leaf hairiness in cotton is of vital importance.

Jassid damage has been known much longer, and is much more widespread in Upland *(G. hirsutum)* than in Egyptian cottons. Jassid like blackarm, tends to be epidemic in some what drier tropics rather than in a wetter forest country. The Punjab, the Northern Sudan, the drier cotton growing areas of E. Africa are typical jassid epidemic localities. This distribution of jassids in the rather drier areas may be partly explained by Hanna's work in the Sudan Gezira, where it was proved that rainfall of sufficient intensity controls jassid by means of mud splash until the cotton plants grow too tall for mud splash to be effective. Thus countries with finely divided soils and a reasonably heavy and well distributed rainfall would not be expected to suffer from epidemic jassid attack.

The connection between hairiness and jassid resistance has been attempted by several workers. Parnell (1928) pointed out that both the length and density of the hairs are concerned in jassid resistance. This was confirmed later by Peat (1928) and others. Parnell (1945) pointed out that hairiness of stem is not essential for even a high degree of resistance and this also holds good for hairiness of petiole and this was confirmed later by Parnell, King and Ruston (1949). It was further pointed out that hairs on lamina and midrib have both influence on resistance but a high degree of midrib hariness is not essential if the lamina is hairy. In the Sudan, cottons with long and dense hairs remain free from hopper burn when the more glabrascent types are heavily damaged by severe infestation with *E. libyca.*

The inheritance of hairiness in New World cottons has been studied from time to time. Worrall (1923) reported a correlation between hairiness and short staple. Parnell (1927) also noted that the heavy yielding jassid resistant plants in a mixed crop tended to be short in staple, but he found that types with 'fairly long lint' combined with jassid resistance could also be selected. Simpson (1947) working with a Pilose Upland mutant found that pilosity and short lint were universally associated and are regarded as pleiotropic effects of a single gene. It was Harland (1929) who first pointed out that fuzz and lint are part of the general hairiness mechanism of the plant and that in selecting hairy cottons for jassid resistance it is probable that lint index and fuzz may be interfered with.

For genetical investigations a representative assortment of hairiest types within each of the two main species of New World cottons *G. barbadense* and *G. hirsutum* was chosen for investigation. *G. tomentosum* was added to the list because of its extreme density of hair population, though its hairs are of negligible length. The varieties investigated in *G. barbadense* are *Carpulla*—A perennial with

strong tomentum; *Tanguis*—a strain now pure breeding for hairiness and plant habit has been insolated by resection; *Sakel* two varieties viz., N. T. 2 and Domains Sakel. Both are susceptible to jassids by reason of their almost glabrous leaves. The varieties chosen in *G. hirsutum* are (1) M. U. 8b. This strain is resistant to both jassid and blackarm and selected in India from Malwa crop by Hutchinson (2) *Kapus Purao*—A jassid resistant American Upland cotton from the Philippines (3) *St. Ignatious* belongs to *G. hirsutum* var *marie galante*—collected from British Guiana. It has lamina hairs of excellent length and fair density. *G. Tomontosum* is a wild type from Hawaii which has a dense tomentum on the lamina surfaces (especially below), composed of hairs of negligible length.

Under Sudan conditions Sakel suffers a very severe jassid attack. *Tanguis* and *carpulla* both show marked resistance but not immunity, while M. U. 8b, Kapas Purao and St. Ignatius are effectively immune. The reaction to *G. tomontosum* is not known as it has never been grown in Sudan in a severe jassid season but it is unlikely to possess any worthwhile resistance.

Investigations on the genetics of the lamina hairiness of the cross Carpulla and Sakel showed that the hairiness of carpulla is controlled by a main partially dominant gene, H_1, accompanied by minor hairiness genes which increase hair density and to a certain extent hair length.

Crosses of Tanguis with Sakel showed that the full lamina hairiness of Tanguis is controlled by H_1 accompanied by a small number of minor genes. The genetical analysis of the crosses between M. U. 8b and Sakel revealed that intensifying genes, augmenting the effect H_1 play an important role in the production of long dense hairs characteristic of M. U. 8b. Minor hairiness genes (as distinct from intensifiers) were of little accounts. In the case of the crosses between St. Ignatius and Sakel, the genetical analysis regarding lamina hairiness showed that H gene from St. Ignatius and H_1 occupy the same locus and since the two genes are phenotypically similar they can probably be regarded as identical. The jassid resistance of St. Ignatius is thus basically due to H_1. Investigations on the lamina hairiness of *G. tomentosum*, with barbadense cross showed that the gene governing the tomentum of *G. tomentosum* occupies a separate locus from H_1 and has been given the symbol H_2 in preference to Harlands' H^{TO}. Studies of the cross of Kapas Purao with Sakel showed that the good length and density of the lamina hairs of Kapas Purao are controlled by a major gene fortified by intensifying genes, minor hairiness genes having an almost negligible effects.

The author is of opinion that jassid resistance is rare in *G. barbadense*, presumably because jassids are not a serious pest in the main areas where barbadense cottons are grown commercially. In the Sudan, jassid has only become severe in the recent years. The reasons for the failure to show resistance by Sudan Sakels have been discussed. It is unlikely that resistance can be built up solely by the action of minor genes in view of the fact that major hairiness gene has been found in each of the jassid resistant types investigated. Since hairy plants of Egyptian type cotton have, however, been noted by several workers in Egypt it is possible that Sakel would evolve jassid resistance types if large areas of the crop were exposed to epidemic attack for a suffieient number of generations. With regard to *G. hirsutum*, jassid resistance is negligible in the variations of U. S. cotton belt, from which the modern Uplands of India and Africa sprang. Strong resistance has been built up in India and in Africa, by selectien under impact of the disease.

The weak resistance evolved in some South Aferican forms of *G. barbadense* by the addition to H_1 of minor hairiness genes which have direct action on the production of hairs. By contrast, *G. hirsutum* acquired resistance by the addition

of intensifying genes, which lengthen the hairs produced by a basic H gene but which in the absence of H have little or no effect.

Summary: (1) Hairs of sufficient length and density on the underside of cotton leaves confer immunity to jassid.

(2) The resistance of Carpulla and Tanguis, two barbadense perennial types, is due to a basic, partially dominant hairiness gene designated H_1, accompanied by a number of minor, hairiness genes.

(3) H_1 is identical with the gene previously called H^D and H^{TAN} by Harland.

(4) Jassid resistance of M. U. 8b, a *G. hirsutum* commercial type from India, is controlled by H_1 accompanied by intensifying genes which augment the effect of H_1. H_1 also provides the genetic basis for the resistance found in St. Ignatius a variety of *G. hirsutum* var *marie galante* from British Guiana.

(5) Resistance of Kapas Purao was found to depend on a gene phenotypically similar to H_1 accompanied by hair length intensifiers.

(6) A hairy density gene H_2 (Harlands H^{TO}) is responsible for the dense tomentum of *G. hirsutum*. (N. K. I.)

CROP AND TRADE REPORTS

Crop Statistics, Madras State, 1953—'54. Cumbu (Bajra) Third or final forecast: The area sown is estimated at 1,402,000 acres. Compared with the final area in the previous year, this is a decrease of 3·6% and is higher than the average area during the five years ended 1952–'53 by 10·9%. Cumbu is not grown in the West Coast and the Nilgiris. An increase in area over that of the previous year is estimated in the districts of South Arcot, Salem, Coimbatore, Tanjore and Tirunelveli and a decrease in the other districts of the State. The main crop has been harvested. The yield per acre is estimated to be higher than that for last year in all the districts of the State. The seasonal factor for the State as a whole works out to 97% of the normal as against the final estimate of 67% for the previous year. On this basis the total yield works out to 347,700 tons of unhusked grain or 278,200 tons in terms of cleaned grain. Compared with the final estimate for the previous year, this represents an increase of 32·9% shows an increase of 46·8% as compared with the average yield for the years ending 1952-53.

Cholam (Jowar) — Third and final forecast: The area sown is estimated at 1,717,300 acres. Compared with the final estimate is a decrease of 5·2% and shows an increase of 1·7 over the average area for the five years ended 1952–'53. Cholam is not grown in the districts of South Kanara and the Nilgiris and it is an insignificant crop in Malabar and Tanjore districts. Compared with the final area of 1952–'53, the present estimate reveals an increase in the districts of Coimbatore, Tanjore, Madurai and Ramanathapuram and a decrease in the other districts of the State except Malabar where the area is expected to be the same as that of last year. The main crop has been harvested in most districts of the State. The yield per acre is expected to be higher than that for next year in all the districts of the State. The seasonl factor for the State as a whole works out to 97% for

Kharif crop and 94% for Rabi crop as against 72% and 71% respectively for the previous year. The total yield for the State works out to 5)7,500 tons of unhusked grain or 474,000 tons of cleaned grain. This represents an increase of 27·8% compared with that for the previous year and an increase of 31·6 over the average yield for the five years ended 1952–'53. The increase is mainly due to better seasonal conditions in the year under report.

Tenai — Third or Final Forecast: The area is estimated at 82,3 0 acres. Compared with the finally recorded area in the previous year, this is a decrease of 9·1%. The present estimate is lower than the average area during the five years ended 1952–53 by 2·3%. The crop is not grown in the South Kanara district. The area estimated is the same as that of the last year in the districts of Tiruchirapalli, Tanjore and the Nilgiris. A decrease in area is estimated in the districts of Chingleput, North Arcot, Salem and Coimbatore and an increase in the other districts of the State. The bulk of the crop has been harvested. The yield per acre for the State as a whole is estimated to be 29·7% higher than that obtained in the last year. The increase is due, in general, to favourable seasonal conditions this year. The seasonal factor for the State as a whole works out to 96% of the normal as against 74% in the previous year. On this basis, the total yield works out to 25,800 tons of unhusked grain or 20,600 tons of cleaned grain. Compared with the final estimate for the previous year, this represents an increase of 16·2% and reveals an increase of 27·1% as compared with the average production for the five years ended 1952–'53.

Varagu — Third or Final Forecost: The area sown is estimated at 623,200 acres. Compared with the final area for the previous year, this reveals an increase of 0·7% and shows a decrease of 2·0% compared with the average area for the five years ended 1952–'53. The crop is not grown in the South Kanara district. Compared with the previous year, an increase in area is estimated in the districts of Chingleput, South Arcot, North Arcot, Salem, Tanjore, Madurai, Tirunelveli and a decrease in the other districts of the State except Malabar where the area estimated is the same as that for last year. The bulk of the crop has been harvested. The yield per acre for the State as a whole is estimated to be 28·9% higher than that obtained during the previous year. The seasonal factor for the State as a whole works out to 98% of the normal as against 76% in the previous year. On this basis, the total yield works out to 269,300 tons of unhusked grain or 161,500 tons of cleaned grain. Compared with the final estimate for the previous year, the present estimate is an increase of 26·3% compared with the average yield for the five years ended 1952–'53. The increase is due, in general, to favourable seasonal conditions this year.

Samai — Third or final forecast: The area sown is estimated at 490,400 acres. Compared with the final area in the previous year, this is a decrease of 6·0% but shows an increase of 22·1% over the average area for the five years ended 1952–'53. The crop is grown mainly in the districts of Nort Arcot, Salem, Coimbatore, Tiruchirapalli, Madurai, Ramanathapuram and Tirunelveli. A fall in area is estimated in the districts of Chingleput, South Arcot, Salem, Madurai and Ramanathapnram. The area estimated in South Kanara District is the same as that of last year. An increase in the area is estimated in the remaining districts except Tanjore where the area under the crop is negligible. The crop has been harvested in most districts of the State. Yield per acre for the State is estimated to be 32·4% higher than that obtained last year. The seasonal factor for the State as a whole works out to 98% of the normal as against 74% in the previous year. On this basis, the yields for the State as a whole works out to 94,600 tons of unhusked grain or 52,000 tons in terms of cleaned grain. Compared with the yield in the

previous year, the present estimate shows an increase of 24·5% and is higher than the average for the five years ended 1952–'53 by 59·0%.

Cotton — Fifth and Final Forecast: The area sown is estimated at 848,500 acres. Compared with the finally recorded area for the previous year and an average area calculated for the five years ending with 1952 — '53, this is an increase of 16·6% and 11·1% respectively. The increase in area is generally attributed to better seasonal conditions in this year. The area estimated is the same as that of last year in South Kanara district. An increase in area is estimated for the other districts of the State except in the Nilgiris district where the area under cotton is little or negligible. Picking of cotton is in progress. The crop was affected by unfavourable weather conditions during the growing period in Tirunelveli district and by insect pest in Coimbatore and Malabar districts. The condition of the crop in other districts is generally satisfactory. The yield per acre is estimated to be higher than that of last year. The seasonal factor for State as a whole works out to 91% of the normal as against 90% for the previous year. On this basis, the total yield works out 264,400 bales of 392 lb. lint as against 213,200 bales of 392 lb. lint for the previous year and an average yield of 256,500 bales for the five years ending with 1952 – '53, representing an increase of 23·1% and 2·3% respectively. It is however too early to estimate the yield with accuracy as much will depend upon the future weather conditions and their effect on the second crop.

The estimated area and yield of cotton by varieties in the current year together with the corresponding figures for the previous year are given below:

Variety	Area in '00 acres		Yield in '00 bales of 392 lb. lint	
	1953 – '54	1952 – '53	1953 – '54	1952 – '53
Madras American (Irrigated)	1007	753	679	492
(Cambodia) (Unirrigated)	1198	920	303	233
Madras American (Irrigated)	421	266	287	173
(Cambodia Uganda) (Unirrigated)	544	346	140	87
Total Cambodia	3170	2285	1409	985
Uppam in Central districts	43	32	7	5
Nadam and Bourban	19	..	–*	..
Total Salems	62	32	7	5
Tirunelvelies (a)	1825	1664	431	401
Karunganni	3428	3294	777	741
Total	5253	4958	1208	1142
Grand Total	8485	7275	2624	2132

(* less than 50 bales). ((a) Includes Uppam and mixed Country Cotton grown in the South).

The wholesale price of cotton lint per standard maund of 82–2/7 lb. or 3200 tolas as reported from certain important market centres on the 1st May 1954 reveal an increase of 8·9% in the case of Tirunelvelies, 1·3% in the case of Coimbatore Karunganni, a decrease of 0·2% in the case of Nadam Cotton. –[Director of Statistics ,Madras].

Weather Review — For the month of June, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	0·8	— 1·1	3·7
	Tirurkuppam*	1·1	— 1·3	4·1
	Vellore	1·5	— 1·3	7·2
	Gudiyatham*	1·0	— 1·0	6·1
East Coast	Palur*	0·3	— 1·7	7·7
	Tindivanam*	0·6	— 0·8	8·7
	Cuddalore	0·7	— 0·7	15·0
	Nagapattinam	0·6	— 0·6	7·2
	Aduturai*	2·2	+ 1·2	10·1
	Pattukottai*	1·5	+ 0·7	16·4
Central	Salem	5·7	+ 2·6	11·7
	Coimbatore (A. M. O.)*	1·5	+ 0·4	11·9
	Coimbatore	1·1	— 0·4	15·3
	Tiruchirapalli	0·1	— 1·7	11·4

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	0·4	— 1·2	12·1
	Pamban	—	— 0·2	11·7
	Koilpatti*	—	— 0·3	18·2
	Palayamcottai	—	— 0·4	10·5
	Ambasamudram*	0·3	— 1·0	18·7
West Coast	Trivandrum	7·7	— 5·5	30·1
	Fort Cochin	36·6	+ 8·1	64·7
	Kozhikode	54·4	+19·6	74·7
	Pattambi*	31·2	+ 4·8	40·3
	Taliparamba*	47·4	+10·1	59·7
	Wynaad*	19·6	+ 5·4	29·7
	Nileshwar*	60·4	+21·0	74·7
	Pilicode*	53·3	+15·4	66·9
	Mangalore	46·2	+ 6·0	56·5
	Kankanady*	46·4	+ 8·1	55·0
Hills	Kodaikanal	4·0	— 0·2	29·1
	Coonoor*	1·3	— 1·3	29·2
	Ootacamund*	3·6	— 0·7	15·3
	Nanjanad*	7·0	+ 0·2	16·5

Note:—1. * Meteorological Stations of the Madras Agric. Dept. 2. — = No rainfall.

The month began with a strong and active monsoon along the West Coast, which became weak on the third day. On the fourth day it regained and kept its activity unabated for five days. On the ninth day it was slightly weak, but on the very next day became active again along the West Coast, and remained so for two days. From the twelfth day on-wards the monsoon remained weak for three days. For seven days from the fifteenth it was fairly active along the West Coast. Again it became weak and continued to be so for four days. Due to a shallow depression in the West Central Bay of Bengal off the Orissa Coast on the 26th day of June the monsoon again became strong and continued its vigour till the end of the month. The general performance of the monsoon along the West Coast and in the districts of Salem, Coimbatore and Tanjore was fairly good. But in other parts of the Madras State it was rather bad, thereby causing anxiety to the farmers as to whether the South-West monsoon rains would fail completely. The note-worthy rainfalls and the zonal rainfall for the month are furnished hereunder: –

Note-worthy Rainfalls for the Month

Date	Name of Place	Rainfall	Name of Zone	Av. rainfall for June	Dep. from normal	Remarks
1/6/54	Fort Cochin	6·0″	North	1·1	— 1·2	Below normal
5/6/54	Mangalore	5·0″	East Coast	1·0	— 0·3	,,
11/6/54	Calicut	9·3″	Central	2·1	+ 0·2	Just above normal
13/6/54	Salem	2·0″	South	0·1	— 0·6	Below normal
18/6/54	Alleppey	4·0″	West Coast	40·3	+ 9·3	Above normal
			Hills	4·0	— 0·5	Below normal

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 12—7—1954

C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATION.

Gazetted Service-Postings and Transfers.

Name	From	To
Abdul Samad	Paddy Specialist, Coimbatore	Supdt. A. R. S. Palur
Fuzlallkhan	Asst. Fruit Specialist, Coonoor	Supdt., Wynad Colonisation Scheme, Wynad
Govinda Kurup K.	P. A. to D. A. O. Salem	D. A. O. Trichy
Kunhikoran Numbiar	Asst. Millet Specialist, Coimbatore	To be in additional charge of Millet Specialist
Mohd. Basheer	Asst. Entomologist, Coimbatore	Asst. Entomologist, Civil Supplies, Madras
Narayanaswami P. S.	Asst. Entomologist, Civil Supplies, Madras	Asst. Entomologist, Civil Supplies, Madras
Ramaswami K.	Supdt., A. R. S. Aduthurai	Paddy Specialist, Coimbatore
Rajarathnam Chetty S.	Agronomist, Siruguppa	Spl. D. A. O. Tanjore
Sahadevan P. C.	S. D. O. Vellore	Asst. Paddy Specialist, Pattambi
Srinivasan V.	Asst. Paddy Specialist, Pattambi	Supdt., A. R. S. Aduthurai
Santhanakrishnan B.	D. A. O. on leave	Asst. Marketing Officer, Madras
Samuel Sundararaj J.	Asst. Fruit Specialist	Asst. Fruit Specialist, Coonoor
Tirumalacharya N. C.	Spl. D. A. O. Salem	Reginonal Campaign Officer, Madras
Uthaman P.	On leave	S. D. O. Vellore

Upper Subordinates-Postings and Transfers.

Name	From	To
Arunachalam T.	S. D. A. Millets, Coimbatore	P. A. to D. A. O. Tanjore
Anavaratham L.	Millet Asst. Koilpatty	Millet Asst. Coimbatore
Ahamad Bavappa K. V.	Paddy Asst. Patambi	Paddy Asst. Aduthurai
Aaron D. S.	Cotton Asst. Koilpatiy	Cotton Asst. Coimbatore
Balasubramaniam	A. A. D. Katpadi	A. D. Vellore

Name	From	To
Baskaran A. R.	Exten. Officer, Mudiri	A. D. Papanasam
Balakrishnan Alwa K. N.	A. D. Karkal	Asst. in Tuber crop, Mangalore
Bindhumadava Rao	Paddy Asst. Aduthurai	Paddy Asst. Pattukottai
Chandrasekharan N. R.	Oil Seed Asst. Tindivanam	Oil Seed Asst. Selam
Chandrasekharan T. K.	Asst. in Chemistry	A. D. Pollachi
Doraiswami G.	A. D. Gobichettipalayam	A. D. North Arcot Dist.
Dorairaj V.	Asst. in Millets, Coimbatore	Asst. Millets, Koilpatty
Doraiswami K.	On leave	Spl. A. D. Nellikuppam
Dakshinamurthy	A. D. Trichengode	P. A. to D. A. Cuddalore
George P. F.	A. D. Tirumangalam	Extension Officer, Panruty
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The Madras Agricultural Journal

Vol. XLI August 1954 No. 8

Editorial

Thirty-Seventh College Day and Conference: This annual function of the Madras Agricultural Students' Union was celebrated this year on the 18th to 22nd August, Sri M. Bhaktavatsalam, Minister for Agriculture, Madras State kindly presided over the deliberations on the 18th August. A large gathering of departmental officers, students and members of the public were present.

Sri R. Balasubramaniam, Principal of the College, welcomed the Minister, Sri N. L. Dutt and other distinguished visitors.' In welcoming them the Principal told the audience how the Minister was responsible for some of the recent important measures taken to improve agricultural conditions in this State. Sri Dutt, he stated, was known internationally through his researches in sugarcane and especially by the wonder cane C. O. 419 which had revolutionised the sugarcane growing in the State. The Secretary, Dr. A. M. Kulandai then read his report on the working of the Union during the year and stressed on the urgent need of increasing the membership of the Union to improve its financial position especially after the disassociation of the Andhra members and on the starting of the Andhra Agricultural Journal.

The President then distributed the prizes to the students who had come out successful in the 1953—54 examinations. Sri S. S. Nagarajan knocked away three prizes and Kumari M. Leela was awarded the prize for Chemistry. Sri S. Varadarajan was awarded the Ramasastrulu Munagala gold medal. Sri M. Bhatavatsalam then delivered his presidential address which is published elsewhere.

This was followed by the address by Sri N. L. Dutt inangurating the symposium on Recent Advances in Agriculture. Sri Dutt gave a very lucid and informative exposition on the recent trends in the breeding of sugarcane including the genetical, physiological, chemical and breeding aspects. The President then in the course of the concluding remark declared open the exhibition arranged for the occasion in several sections of the Institute.

The second session was held during the afternoon of the 18th when several papers contributed for the symposium were presented. Dr. K. C. Naik gave an interesting and thought-provoking introductory address on the highlights of recent advances in agriculture.

This was followed by a talk by Sri S. N. Venkataraman on Propaganda and Plant Protection. Not all the papers could be presented during this session due to want of time. A list of papers contributed is given elsewhere.

On the 19th forenoon was held the Annual Farmers' Day. Several local farmers, farm labourers and a number of departmental officers and other visitors were present, The Minister for Agriculture presided over the occasion. The entire proceedings was in the regional language in which a number of farmers took part. During this Conference the students of the Young Farmers' Agricultural Course were also present and took part in all the College Day Functions.

The forenoon of the 20th, was devoted to the Centenary Celebration of the Madras Herbarium. It was a unique occasion this year that the centenary celebrations coincided with the College Day and Conference, with Dr. A. Lakshmanaswami Mudaliar, Vice-Chancellor of the Madras University occupying the Chair. The function started with a welcome address by the Director of Agriculture, Madras, reading of the report and messages by Sri C. Rajasekhara Mudaliar, Systematic Botanist and Professor of Botany, Agricultural College, introductory speech by the Minister for Agriculture and address by the Chairman, Dr. A. L. Mudaliar. A vote of thanks was proposed by the Principal. An exhibition was arranged at the Madras Herbarium. This was formally opened by the Vice-Chancellor. The exhibition was a very interesting one portraying all the important features of a herbarium and the role it has to play in the economic aspects of botanical and other sciences. The Herbarium sheets exhibited included some collections made in 1797 and 1853 A. D. The exhibition drew a large number of visitors.

The Departmental Officers' Conference and the Scientific Workers' Conference were held on the afternoons of the 19th and 20th. Several important problems were discussed during the Departmental Officers' Conference and a number of interesting papers were presented for the Scientific Workers' Conference and gave rise to animated discussion.

On the 21st of August was held the College Day Sports and Tea. All the events were very keenly contested and the Director of Agriculture was kind enough to give away the prizes to the successful competitors. The championship cup was awarded to Sri M. Marappan student third B. Sc. (Ag.) class.

With the holding of the General Body Meeting of the Union on the 22nd forenoon the College Day functions came to a close.

Groundnut Rotation Experiment *

by

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AND

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Introduction: The importance of rotation in crop production is well recognised. But this practice is not widely adopted in the Madras State probably due to the small size of the average holding of the cultivator. Groundnut being an important money crop of the drylands, is being grown year after year in the same land without any rotation. Judging from the present methods of harvest of the crop whereby the vines and some portion of the roots are removed from the soil, the practice of growing groundnut continuously in the same land is likely to have adverse effects though not immediately atleast in the course of some years. Where rotation is practised, it has been the experience of cultivators that crops following groundnut generally yield well. The spreading type of groundnut which is grown in rotation with *Varagu (Paspalum scrobiculatum)* by a few cultivators in South Arcot district is said to yield better than the same type of groundnut grown year after year without rotation. Rotations vary in the different producing areas depending upon a number of factors, such as, nature of soil, local conditions and demand, solvency of the cultivator, etc. In this State groundnut is generally rotated with cereals like *Cumbu (Pennisetum typhoides)*, *Cholam (Sorghum vulgare)*, *Varagu* and *Tenai (Setaria italica)* in dry lands. In favourable situations groundnut is followed in the same year by maize, *Varagu, Cholam,* cotton, gingelly and horsegram.

With the object of studying the effect of growing 1. groundnut on the succeeding crop of cereals like *Cholam, Cumbu* and *Varagu*, 2. cereals on the succeeding crop of groundnut and 3. which of the rotations is remunerative to the cultivator, the rotation experiment with groundnut was started at the Agricultural Research Station, Tindivanam in 1945 and is being continued. The experiment was carried out during the monsoon under rainfed conditions each year. The soil on which it is being conducted is light red sandy loam and is representative of the large portion of the dryland area of South Arcot and other neighbouring districts. The experi-

* Presented before the 11th Meeting of the Study Group Agricultural Research Institute, Coimbatore; March 1952.

ment has now been in progress for seven years ending 1951. The data relating to the first six years of the experiment and the results obtained therefrom are presented in this paper.

Review of Previous Work: A trial on the continuous growing of groundnut with and without manuring carried out for seven years at the old Palakuppam (near Tindivanam) Farm has shown that continuous cropping of groundnut without manuring reduces the yield (22 percent) and that to a marked extent in years of low and badly distributed rainfall (1935). Similar result was obtained at the Palur Farm where continuous growing of groundnut without rotation reduced its yield (1922). The beneficial effects of raising crops in rotation with groundnut have been reported by different workers. At the Hebbal Farm in Mysore, the yield of *Ragi* has been increased by 27 percent by growing it in rotation with groundnut (1930). Experiments conducted in black cotton soil of Berar have shown that growing cotton after groundnut resulted in 135 percent increase in its yield as compared with that grown continuously without rotation (1933). In Malaya, paddy grown after a groundnut crop recorded an increased yield of 24 percent over paddy grown after paddy (1950). In the experiment conducted at the Agricultural Research Station, Nandyal for six years to study the effect of different rotations on the main crop of the locality, viz., cotton, *Cholam* and groundnut, it was found that *Cholam* followed by groundnut gave the highest yield in grain and straw and that the effect of rotation on the yield of groundnut was negligible. Based on the results of the experiment, a three course rotation of *Cholam* groundnut and cotton is recommended for the tract in preference to the time honoured rotation of cotton and *Cholam*.

Experimental Details: The experiment consisted of the following eleven treatments :—

Groundnut after groundnut
Groundnut after *Cholam*
Groundnut after *Cumbu*
Groundnut after *Varagu*
Cholam after groundnut
Groundnut in the first season followed by gingelly in the second season of the same year.
Cumbu after groundnut
Varagu after groundnut
Cholam after *Cholam*
Varagu after *Varagu*
Cumbu after *Cumbu*

The last treatment was included in this trial as it forms one of the common rotations practised by the dryland cultivator of the tract where the Agricultural Research Station, Tindivanam is located.

Two series of experiments one with the short duration bunch type and the other with the long duration spreading type of groundnut are being conducted. The simple randomised blocks lay-out with four replications is being adopted. The size of the plots is 68′ x 13′ (gross) and 60′ x 6′ or 1/121 acre (net). TMV 2 bunch strain of groundnut is sown to a spacing of 6″ x 6″ while TMV. 3. spreading strain of groundnut is sown to a spacing of 9″ x 9″. The local varieties of the three cereals are sown in lines 1′ apart with plants spaced 6″ in the row. TMV. 1. strain of gingelly is sown

broadcast and the plants subsequently thinned to a spacing of about 9″ between plant and plant.

Data collected: During the crop season, notes on the effects of the season, on growth, flowering and fruiting, incidence of pests and diseases, etc., are taken. Details of labour employed for the various field operations are recorded throughout the crop season as and when they are carried out. At harvest time the yield of grain and straw are recorded for each of the crops and for the individual plots. For purposes of comparison of yields, only the produce obtained from the net size of plots is utilised.

Discussions: (a) *Seasons:* During the period this experiment has been in progress, the seasonal conditions have not been normal. Under these conditions yield of the crops was not quite satisfactory. Among the two groundnut types, the long duration spreading type suffered more on account of the failure of the north-east monsoon during the last three years. The cereals were affected to a greater extent than groundnut. For want of rains, the sowing of the second crop of gingelly could not be done in the 'groundnut gingelly' plots during the last three years.

(b) *Yields:* The yield of the groundnut crop following other crops was compared with the yield of groundnut grown continuously year after year. Similarly, the yield of cereals grown after groundnut was compared with the yield obtained from their continuous cropping. Though the yield data of the six seasons are available yet the figures of the first year have been left out as it happens to be the basic year when no comparison between the treatments is possible. Hence only data of the remaining five seasons have been actually utilised for comparison of the different sets of treatments. A summary of the analyses of the yield data is presented in Table I.

In the bunch series, groundnut following cereals has given small increases in yield varying from 4·5 percent to 12·0 percent. But in the spreading series only groundnut following *Cumbu* has recorded an increase of 5·5 percent. Groundnut after *Cholam* and after 'groundnut - gingelly' has actually suffered certain reduction in yield in the latter series. But all these differences are not statistically significant. The experience of South Arcot cultivators of the groundnut crop giving increased yield when it follows a *Varagu* crop is not borne but by the data obtained in this experiment.

TABLE I

Treatments	Bunch Series: Acre yield in lb.	Bunch Series: Percentage over control	Bunch Series: Significance of treatment differences (5% level)	Spreading Series: Acre yield in lb.	Spreading Series: Percentage over control	Spreading Series: Significance of treatment difference (5% level)
(a) Yield of the groundnut crops (Average of five years)						
Groundnut after groundnut	884	100·0	—	843	100·0	—
Groundnut after *Cholam*	983	112·0	Not Significant	770	91·3	Not Significant
Groundnut after *Cumbu*	959	109·2	—	890	105·5	—
Groundnut after *Varagu*	935	106·5	—	849	100·7	—
Groundnut after groundnut gingelly	917	104·5	—	812	96·3	—
(b) Yield of Cereals (Average of five years)						
Cholam after *Cholam*	327	100·0	Significant	426	100·0	Significant
Cholam after groundnut	732	223·8	—	714	167·6	—
Cumbu after *Cumbu*	282	100·0	Significant	268	100·0	Significant
Cumbu after Groundnut	402	142·6	—	433	161·0	—
Cumbu after groundnut	402	142·6	—	433	161·0	—
Varagu after *Varagu*	223	100·0	Significant	436	100·0	Not Significant
Varagu after groundnut	484	217·0	—	460	103·1	—

When the yields of cereals after groundnut are compared with cereals following cereals, the results are striking. The cereals after groundnut have recorded outstanding increase in yield of 43 percent to 124 percent over cereals which are grown year after year without rotation. These increases in yield are significant excepting in the spreading series where *Varagu* follows groundnut. This may probably be due to the poor stand observed in *Varagu* plots in certain seasons. This, however, requires further confirmation. From the above results it is evident that cereals grown in rotation with groundnut are greatly benefitted and give marked increase in yields over cereals after cereals. Of the three cereals, *Cholam* seems to derive maximum benefit by being grown after groundnut.

Economics: The cost of cultivation and the value of produce obtained for each of the crops were worked out each year and the

average net profit or loss per acre in rupees for each of the crops is given in the table below:

TABLE II

Groundnut Rotation Experiment—Economics of Cultivation
(Average of six years—five comparisons)

Treatments	Bunch Series	Spreading Series
(a) Single Crops		
Groundnut after groundnut ..	82	73
Groundnut after *Cholam* ..	107	60
Groundnut after *Cumbu* ..	102	86
Groundnut after *Varagu* ..	96	75
(b) Comparison of the Rotations		
Cholam after *Cholam* ..	28	13
Cholam after groundnut ..	123	78
Cumbu after *Cumbu* ..	33	37
Cumbu after groundnut ..	83	71
Varagu after *Varagu* ..	46	13
Varagu after groundnut ..	81	63

Groundnut cultivation under the different systems of cropping has resulted in a fair margin of profit ranging from Rs. 60/- to Rs. 107/- per acre. The bunch groundnut following cereals has given a better return than the same type of groundnut grown year after year. Similar profit in the case of the spreading type has been obtained only when it follows a *Cumbu* crop. In the case of cereals, only *Cholam* following groundnut has registered a small profit. In all other cases, their cultivation has resulted in loss. This is due to the low yield obtained and to the valuation of their produce at controlled rates. When the rotations are compared with cereals following cereals the latter have resulted in loss while those following groundnut have recorded substantial profits. Maximum profit has been registered for 'groundnut—*Cholam*' rotation in both the serves.

Conclusion: From the results of the analyses of the yield data relating to the experiment it is clear, that cereals following groundnut give comparatively high yields than cereals following cereals. The groundnut crop on the other hand does not seem to benefit to any appreciable extent by its being grown in rotation with the cereals. Groundnut cultivation has resulted in good monetary returns on

account of its high market value. The bunch groundnut following cereals has given better return than the same type grown year after year. Growing of cereals has generally resulted in loss excepting in the case of *Cholam* grown after groundnut. Considering the economics of the different rotations 'groundnut—*Cholam*' rotation appears to be the most profitable one for tracts where the bunch type of groundnut is largely grown.

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SNIPPETS

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" Yes, and can you see any results "?

" Sure, the roller is much thinner ".

Research Note.

Tests with Different Proportions of Zinc Phosphide Poison in the Baits used for the Field Rat— *Bandicota Bengalensis* G and K

For the control of the field rats in paddy fields, zinc phosphide at 5% level was recommended to be used in the baits. Experiments were carried out to minimise the dosage of zinc phosphide in the bait in Krishna and Guntur districts during 1949, for the efficient control of field rats. Accordingly baiting in the form of cooked rice containing 1, 2, 3, 4 and 5% of zinc phosphide were tried and relative mortalities of rats in different doses were recorded. The results indicated that 2% zinc phosphide was found quite satisfactory in controlling rats. The Food and Agricultural Organisation Conference Proceedings held at London in 1947 on 'preservation of grains in storage' have also recommended the use of zinc phosphide in 2·5% proportion with wet baits and our conclusion that zinc phosphide is best used at 2% proportion in cooked rice confirms the findings. The incorporation of fried onions to zinc phosphide at 2% strength added to the efficiency of the bait. However, when 5% baits were used, the mortality occurred within 3 to 5 hours whereas at 2% level it was delayed up to 12 hours. The lower percentage has the advantage of making the baits more acceptable to the rodents besides reducing the cost per acre of the control measure.

In Tanjore district, popped rice containing 5% zinc phosphide was being used for baiting against rats. Experiments were consequently undertaken at Aduthurai with caged rats of similar size during November 1952 using zinc phosphide ranging from 1 to 5% in the poison bait (popped rice + fried onions + fish bits + zinc phosphide). The findings of the experiment are that even with popped rice, zinc phosphide is best used at 2% proportion to reduce the cost of baiting and increase its acceptability. The rats were found dead within a period of 10 hours with 2% zinc phosphide baits. This change in baiting which was given effect to from December 1952 at the Agricultural Research Station, Aduturai, has given satisfactory results so far and it may be adopted in baiting for rats by anybody now.

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T. SANTHANARAMAN,
K. R. MOHAN RAO.

THIRTY-SEVENTH COLLEGE DAY & CONFERENCE

★

Welcome Address by the Principal

Hon'ble Minister for Agriculture, Madras, Sri N. L. Dutt, Ladies and Gentlemen,

It is my proud privilege and honour as the Principal of the Agricultural College and Research Institute, Coimbatore and President of the Madras Agricultural Students' Union to accord a hearty welcome to all those assembled here on the occasion of the thirty-seventh College Day and Conference. The Union is indeed very fortunate to secure the presence of Sri M. Bhaktavatsalam, Minister for Agriculture, Madras for presiding over the proceedings of the Conference. It is a gesture which we greatly appreciate. Although he has been in charge of the portfolio of Agriculture from the time of partition of the State, he has taken such an abiding interest in matters relating to Agricultural Research, Extension and Education, that evidence of his personal direction is apparent in the enumeration of new policies for increasing production and in the expansion of Agricultural Education.

The Union is equally indebted to Sri N. L. Dutt for having accepted to inaugurate the conference and to preside over the symposium on 'Recent Advances in Agriculture' chosen as subject of this year's conference. His work on sugarcane is in keeping with the best traditions of the section which has contributed not a little to the development of Sugar Industry of India. Being the Head of our neighbouring sister Instistute, he is already well known in scientific world of the Indian Union and I am sure that as Chairman of the symposium, he will bring his ripe experience and wisdom in guiding the deliberations.

The Agricultural Education in Madras continues to attract young men desirous of making agriculture their profession or a means of service. Sixty one out of 76 students who appeared for the final examination in B. Sc. (Ag.) held in April 1954 came out successful. All the fifty seven graduates belonging to the Madras State were appointed in the existing vacancies of the Department. The admission to the First year B. Sc. (Ag.) class of 1954-'55 was raised from 96 to 108 on account of the loss of seats reserved for Madras candidates at the Agricultural College, Bapatla after the partition. The number of applications received for admission during the year was appreciably larger than the previous years. All the 108 seats were filled up. One notable feature of the year was the desire of educated youth drawn from farming communities owning large extent of lands to take up agricultural education with a view to go back to their

farms at the end of the course. It is a change which is to be welcomed and fostered. The rules and syllabus relating to the six months practical training for the B. Sc. (Ag.) under revised regulations were adopted by the Madras University and Government. The students who were admitted in the academic year 1953–'54 would be the first batch to benefit by the training.

The first Post graduate Diploma course in Horticulture affiliated to the University of Madras was commenced at Coimbatore on the 14th August 1953 with a complement of 25 trainees, of whom twelve and eight were selected from the upper subordinates of Madras and Andhra States respectively, one nominee was from the Hyderabad State and four others were private candidates.

The Government sanctioned a scheme for running a Refresher course in Agriculture for young farmers for a period of six months in order to give an all round practical training in Agriculture and allied subjects to the farmers within the age group af 17 to 25 years. The first year course was run from July to December 1953 at the Central Farm. Fourteen trainees consisting of eleven Tamil and three other Malayalee farmers transferred from Taliparamba centre during September 1953 underwent training in the regional Tamil language under an Agricultural Instructor specially appointed for this course. The trainees secured the full benefit of instruction and went back to their lands. The facilities have been extended during this year too and 27 young men have joined and are undergoing the course.

In congratulating the various prize winners of the year, I exhort them to contribute their best in the field of extension or research, whichever may be their allotted lot while in service in the department. It is creditable that the students of the year have been able to make a mark in the field of sports, art, debates and literary activities. This year's Tatler is a glorious achievement both in matter and get up. It has evoked appreciation from all educational institutions.

The Union continued to strive its utmost to disseminate scientific knowledge through its journal published monthly in spite of bottlenecks in finance especially after partition. I appeal to brother officers to make liberal donations even at some personal sacrifice and sustain the spirit of service behind the publication of the journal.

I also take this opportunity to extend a very cordial welcome to various officers of the department, members of the public, students, farmers and others assembled here.

Report of the Secretary of the M. A. S. Union

Ladies and Gentlemen,

On behalf of the Madras Agricultural Students' Union I extend a hearty welcome to you all and have great pleasure in presenting to you the report for the year 1953—'54.

The Union is extremely fortunate in being able to secure the presence of Sri M. Bhaktavatsalam, Minister for Agriculture to the Government of Madras, to inaugurate the deliberations of this Conference this year. When he accepted our invitation at great personal inconvenience and amidst his multifarious duties that devolve on the ministerial chair which he occupies, we fully realise that thereby he has shown his keen interest and enthusiasm in matters relating to Agricultural development. He has been known as a patriot of the front rank, who has set his heart to the improvement of this State and the State is fortunate in having him at the helm of affairs in the Development of Agriculture. The implementation of the National Extension Service Scheme in Tanjore district, with its aim "to organise the Villages for a happier, more prosperous and fuller life in which the individual Villager will have the opportunity to develop both as an individual and as a unit of a well integrated Society", is in no small measure due to the energy and enthusiasm of our Minister and the success which is bound to ensue, will be a monument to his efforts. On behalf of the Union please permit me, Sir, to offer our thanks for the readiness with which you have consented to accede to our request to inaugurate the deliberations of this year's Conference.

It is also our proud privilege to have on this occasion Sri N. L. Dutt, Director of the Central Sugarcane Institute to address us to-day. He is a worthy successor to the eminent Sugarcane Scientist Dr. T. S. Venkataraman, who addressed this Conference last year. We have great pleasure in welcoming him. His reputation as a Scientist is known far and wide. But his association with the Union and his keen interest in its very many activities and its progress may not be so well known. He has always evinced a sustained interest in our Union, of which he has been a member for many years, and has functioned in various capacities in its multifarious activities and to-day, in spite of his many onerous duties and responsibilities of running a great Institute, he has graciously consented to be present on this occasion and to preside over its deliberations. For all this, the Union owes him a deep debt of gratitude.

The Madras Agricultural Students' Union: The Union was founded by a handful of enthusiastic workers in the year 1911 with the objective of bringing together the past and present Students of the Agricultural College, Coimbatore. With the formation of the Agricultural College at

Bapatla the Students of that College also joined and strengthened the Union until recently. The Union has been flourishing as an independent and voluntary organisation serving as a link between the past and the present Students of the two Colleges. The Union can also proudly state that through the medium of its Journal it disseminates knowledge and information on Agricultural matters of the State to the public and to the departmental members and acts as an important link between the research worker and the farmer.

The Andhra Agricultural Journal: With the partition of the State during the year many of our members were transferred to the Andhra State and it is gratifying to note that they lost no time in starting a Journal of their own, viz., "The Andhra Agricultural Journal." We wish our contemporary a long and useful career in the cause of the common ideal, namely, the development of Agriculture in the Country.

The Madras Agricultural Journal: Despite the fact that there was a fall in the strength of members due to partition of the State, the Journal has been published regularly throughout the year and we are proud to note that research workers in other Institutions and Departments have recognised its place among the scientific publications of the world. The Journal has acquired an international reputation and is on the exchange list of a large number of Scientific publications of India and Abroad.

Finance: The most important activity of the Union is the publication of the Journal. Financial resources is the bottle-neck which is limiting its expansion. A big slice of the budget is spent towards meeting the cost of paper and printing charges. With none too bright a financial position before, and the discontinuance of membership of a large number of erstwhile Andhra members, the Union is now facing hard days. In this connection the Union desires to express and place on record its deep sense of gratitude to the Government of Madras for the special grant of Rs. 1,800/- sanctioned annually since 1947—'48. We take this opportunity to make an earnest appeal to all the past and present students of this College, the officers of the Department and the farmers who are not yet members of the Union, to enroll themselves as members and strengthen the Union so that it may function, flourish and continue its activities. We also appeal to all our members to enlist as many new subscribers as possible, thereby helping the Union to sustain itself during the years to come.

College Day and Conference, 1953: The celebration of the College Day and Conference is an annual feature of the activities of the Union. The Thirty-sixth College Day and Conference was celebrated last year from the 17th to 20th of August. The Conference was inaugurated by Dr. Punjabrao Deshmukh, Union Minister for Agriculture. The Presidential address was delivered by Dr. T. S. Venkataraman, retired Sugarcane Expert and the subsequent sessions were presided over by

Sri M. S. Sivaraman, I. C. S., Director of Agriculture of our State. A symposium on "The Agricultural Department and its contribution to the Agricultural prosperity of the Madras State" was organised and it provided ample scope for discussion in which a number of Departmental officers and non-official visitors participated. An account of the proceedings of the College Day and Conference was published in the August issue of the Madras Agricultural Journal.

Meetings Under the Auspices of the Union: During the year the following three lectures were arranged under the auspices of the Union.

(1) "Japan and Japanese Agriculture" by Sri M. B. V. Narasinga Rao, Paddy Specialist, Andhra State.

(2) "Recent trends in Plant Pathology" by Professor T. S. Sadasivam, Director, University Botany Laboratory, Madras.

(3) "Life with the Farmers of America" by Sri N. K. Natarajan, Ford Foundation Farmer-scholar.

Ramasastrulu Munagala Prize: The paper on "Enzymatic Studies of Aspergillus oryzae" was adjudged the best by a panel of three judges and the award was made to Sri S. Varadarajan of the Chemistry Section. Our thanks are due to Dr. G. S. Siddappa, Dr. P. Satyanarayana and Dr. S. Krishnamurthy for very kindly acting as judges for this year's competition.

A silver medal was this year presented by Sri K. Venkitaswami Naidu for second best essay. This was awarded to S. Venkatachalam of the chemistry section.

Patrons: We are glad to report that during the year two gentlemen were added to our list of patrons and the Union extends its hearty welcome to Sri N. S. Vaidyanatha Iyer of Sengalipuram and Sri K. P. Amirthanatha Iyer of Monkombu, our new patrons.

Retirement: During the year three of our active members of the Union retired from Government service. They are Sri M. R. Balakrishnan, Sri V. Gomathinayagam Pillai and Sri G. Sakharama Rao. Sri M. R. Balakrishnan has served the Union in various capacities and tended and nurtured it during its difficult times. Though he has retired from service he continues to be a member of the Union and is at the present moment its Vice-President. Sri V. Gomathinayagam Pillai has also rendered service to the Union in various capacities during the earlier years of his career. Sri G. Sakharama Rao has been associated with the Union as its member for a very long time. The Union offers its felicitations to them for their valuable services in various capacities and as members of the Union.

Obituary: The Union records with a deep sense of sorrow, the demise of the following members who were associated with the Journal

and the Union for a long time. They are the late P. D. Karunakar, K. Ramanujachari and S. Sundararama Iyer. Late S. Sundararama Iyer and P. D. Karunakar were Ex-Officio Presidents for some time and were also Editors and had served in several other capacities for the betterment of the Union.

Acknowledgment : Lastly, it is my pleasant duty to express on behalf of the Union our heartfelt thanks to all those who have helped the Union during the year in various capacities. To Dr. Punjabarao Deshmukh, the Union owes a great debt of gratitude for inaugurating the last year's Conference. To Dr. T. S. Venkataraman, who presided over the symposium and delivered the address, the Union tenders its heartfelt thanks. To Dr. R. Naganna Gowd, who made the welcome speech on the occasion of the last year's deliberations, the Union is highly grateful. To Sri M. S. Sivaraman, I. C. S., Director of Agriculture, Madras, the Managing Committee is highly indebted for his never failing help and guidance offered so liberally. To Sri R. Balasubramaniam, Principal of the Agricultural College and Research Institute, Coimbatore, for his valuable advice, help and interest in making last year's College Day and Conference a grand success, the Union expresses its thanks. Our thanks are also due to all the ladies and gentlemen who helped the Union in many ways to successfully conduct the College Day and Conference in 1953 and during the year under report.

A. Mariakulandai,
Secretary.

President's Opening Speech by Sri M. Bhaktavatsalam, Minister for Agriculture, Madras

Ladies and Gentlemen,

I have very great pleasure in inaugurating the 37th Agricultural College Day and Conference. This is an occasion which provides not only an opportunity for practical farmers and non-officials interested in Agriculture to mix with students of Agriculture and officers of the Agricultural Department but also a valuable forum for the latter to exchange opinions and experiences among themselves. This year's Conference is unique in that it synchronises with the completion of 100 years of useful existence of the Madras State Herbarium which is located in the College.

Inaugurating the College Day and Conference last year, Dr. Panjab Rao Deshmukh, the Union Minister for Agriculture stressed the need for farmers organising themselves, as such organisations were conducive not only to development of agriculture and greater production but also tended to ensure the social and political solidarity of the country. This suggestion is taking shape and the Government of India are taking

steps to convene an All India Conference of Farmers at an early date. I attended a preliminary meeting to discuss this question which was held at Srinagar last month. I hope that an All India organisation of farmers will come into being ere long. I also hope that there will be the closest co-operation between the State organisation of farmers and the Madras Agricultural Students' Union for their mutual benefit.

In his welcome address, the Principal has given a summary of the varied activities in agricultural education in this State at present. I should like particularly to invite the attention of this gathering to the increasing stress that is now being laid by the Government on making agricultural courses both in this College and outside more practical. The University of Madras has whole heartedly agreed to the suggestion to institute a six months' practical training for the B. SC. (AG.) students to be imparted in the various Agricultural Research Stations of this State. When this intensive practical course is imparted, supplementing the theoretical-cum-practical course of instruction at this Agricultural College and in the Farms attached to this Institute, we shall no longer, I hope, hear the remark that is being often made, that the Agricultural graduates turned out by this College are not necessarily cent per cent practical farmers. Alongside this change in the curriculam of this College, the Government have also forseen the need for training the young farmers, for whose benefit a refresher course in Agriculture is being run since last year for a period of six months at this Institute. All these are in addition to the facilities for training in agricultural practice, that are made available by the Government at all the Agricultural Research Stations. With all these varied opportunities available for getting training in modern scientific methods of agriculture, if the public are not making full use of them, the reason may perhaps be that with the agriculturist, tradition dies hard. It is for the Madras Agricultural Students' Union to spread their message more and more to the youth among the farming community and thus kindle in them the desire and keenness to profit by the knowledge that the Department is waiting to impart to them. Quite apart from the education of the farming community and the graduates in agriculture, the Department has felt the need for a different type of training to promote the efficiency of the research work. You are all well aware that in these days the march of science is so rapid that unless the research workers and scientific men can keep step with this progress, they will soon be left behind as back numbers. It is inconceivable that a research worker can maintain the keen edge of his efficiency by merely banking on the education received at his College or on the knowledge acquired prior to his entering the service. The provision for a constant ingress of new ideas and fresh knowledge of up-to-date technique evolved in all parts of the world, is the only means of maintaining the efficiency of our research organisation at the top level. All this would mean the institution of a comprehensive post-graduate research training system.

Here too, the University of Madras have recently recognised Coimbatore as the Centre for post-graduate courses leading to the Degrees of M. SC., and Ph., D. It is hoped all these facilities will be availed of to the maximum extent possible. In this connection I would like to make a suggestion. Provision may perhaps be made for students to obtain the M. SC. degree in Agriculture by examination also at the Agricultural College."

The Minister then stressed the need to begin the agricultural education even from High School standards so as to create an agricultural bias in them. Already 13 schools with a total of nearly 1000 pupils are following this altered curriculam in this State. In the current year he said 25 more schools would be coming under this curriculam.

Referring to the exhibition put up at the Agricultural Research Institute he said that the exhibition may, if possible, be made to cover allied matters such as poultry breeding, farm animals and pisciculture and also for the display of agro-industrial products made in the home and cottage. The exhibition can also be made more popular by instituting a prize for plants and flowers collected and pets kept by school children. Thus opportunity may be taken to inculcate in the young mind the love of plants, flowers and birds that they see around them. He also suggested that the staff of the college may exhibit vegetables etc. grown by themselves in order to make the exhibition really practical and attract the attention of the lay public and also to provide the answer to the oft-repeated charge that the Departmental staff are not practical farmers.

After a long period of difficulties through which our State passed in the matter of food production, Nature has been bountiful to us now, and we have almost turned the corner. Our problem in the State, in so far as the food front is concerned, is to step up the yield from the available area to meet the cereal needs of the growing population. The use of improved seeds evolved by the Agricultural Department, adequate manuring, proper cultivation practices and protection of plants from pests and diseases, are the planks adopted towards this all-important objective. It is really a problem as to why, inspite of there being hundreds of improved strains of the various crops in the State, the ryots have not fully taken to the use of improved seeds, of the superior departmental strains. Similarly, the question arises as to why if a particular manure or an agricultural practice is found to be the best, still it is not adopted whole-heartedly or fully by all the ryots. Again, the drive given by the Department to increase the production of green manure crops through the simplest and most inexpensive methods remain also yet to be adopted throughout the length and breadth of this State. Recently, in order to infuse greater confidence among the public in the work of the Agricultural Department and to dis-abuse the general feeling among the public that the Agricultural Research Stations of the Government are run at a loss, a drive has been launched, the result of which

is that, despite the fact that these Stations are intended solely for pursuing research and have to be maintained at a certain standard, it has now been proved that they can be run on a self-sufficient basis also, if not on a profitable basis. The success of this drive is reflected in the fact that the total expenditure on 24 Agricultural Research Stations was brought down from Rs. 6·13 lakhs in 1951—'52 to 5·58 lakhs in 1953—'54, while the receipts have been stepped up from 3·50 lakhs to 5·76 lakhs respectively. This saving would not be worthwhile if the main function of research is given up but if self-financing is achieved without sacrificing research, these Stations would be doubly useful as research centres as well as model farms. Besides these Stations, something more has to be done to spread the improvements and messages of the Agricultural Department most speedily and effectively. It is here that the Community Project areas and the National Extension Service Blocks come into the picture. The all-embracing activities of these well planned and coordidated organisations, representing a nationwide drive, are expected to bring the message of scientific agriculture to the very door of the cultivator. The Madras Agricultural Students' Union as well as the farmers who have assembled to-day in this Conference could well deem it an act of service to the State by participating with all enthusiasm in this nationwide drive for the regeneration or amelioration of our Agriculture."

The Minister then referred to the Improved Japanese method of paddy cultivation and the campaign launched last year. A modified method of cultivation based on the above is now being extended to millets and cotton. He appealed to the Farmers to fully co-operate in this drive to increase production of food etc.

"I have one word more to say. Agriculture is a vast science. Nay, it is an art. No one can claim to take credit of having served agriculture by concentrating on just a few of its aspects. An integral concept, with thorough devotion to fundamentals of theory and practice is necessary. Further, a sense of team work, co-operation and intellectual honesty alone will be productive of practical results. May you, as members or prospective members of this scientific and Nation-building profession in a Welfare State keep these ideals in view, ever and always.

It is now my pleasant duty to request Sri Nanda Lall Dutt to deliver his address. Sri Dutt is no stranger to us. As you may be aware, one of the outstanding results of his work is the C. O. 419, the wonder cane of India which dominates the whole of peninsular India and which has given record yields and recovery comparable to the best performances in the other sugarcane countries in the world like Hawaii, Java, etc. Our own State has benefited immensely from Shri Dutt's work as C. O. 419 which he gave to us now occupies a leading position in all cane tracts in Madras. I have now very great pleasure in requesting Shri Dutt to deliver his address".

SOME ASPECTS OF THE ADVANCING FRONT OF AGRICULTURAL SCIENCES

Address by Shri N. L. Dutt, Director, Sugarcane Breeding Institute, Coimbatore

Shri Dutt prefaced his address with a comparison of the conditions of work now and about three decades ago. He said that there is a welcome change now not only in our national policies, plans and programmes, but also in our approach to our problems and in our very conception of what is our duty and function as parts of the national machinery for agricultural development. The idea now is one of effective service to the farmer, and the raising and maintenance of good crops in the country is now as much the responsibility of the department in the national interest as of the farmer himself. He drew pointed attention to the great improvements in the service to the farmers whether it be in agricultural engineering, plant protection or agronomical advice.

One wonders whether even a decade ago it would have been thought possible that the functions of the Agricultural Departments would come to cover such activities as Rural Welfare Scheme, Hill Tribe Uplift Scheme, Colonization Scheme, National Extension Service and Community Projects. The object of the Community Projects is nothing less than to secure the fullest development of material and human resources of the area — a highly desirable and laudable object. One more activity deserves mention and that is the Soil Conservation Scheme under which contour bunding and other linked soil and moisture conservation measures have been adopted. If these recommendations have found acceptance and willing execution from the growers, it can only have been through conviction born out of the personal persuasive efforts and the service-minded approach of the agricultural development worker. Steadily over the past few years since 1947, the change from 'advice' to service has been taking place and now it is one of the principal wheels on which the implementation of our 5-year plans has to move forward. It behoves all of us, in whatever sphere we are placed, to put our shoulders to the wheel, and it should be the special privilege of the young workers who have joined the ranks in the Agricultural Department to inculcate the idea of service and to put out the best effort they are capable of in the cause of our Nation.

I have taken the liberty of prefacing my address with the above remarks as I felt that our young workers should make a particular note of this necessary change in the outlook of agricultural scientists in the context of service to our Nation. And now I propose to take you rapidly over the main theme of this address, viz., how the concept in the agricultural sciences has advanced on a widening front. No attempt has been made to take all the agricultural sciences or even to deal comprehensively with those that have been taken, but merely to illustrate the point of a widening front.

Genetics and Cytogenetics: Among the most fundamental studies affecting plant breeding in particular and biological sciences in general are the researcees on the nature of the gene. Following upon a series of discoveries of far reaching importance on the material basis and mechanism of heredity in plants and animals, recent studies in biochemical genetics have suggested in essence that the gene is a nucleoprotein endowed with the quality of self-duplication and controlling the function and characteristics of the organism through a complex biochemical mechanism involving the production and action of enzymes. The specificity of gene-action is accounted for by the hypothesis of "one-gene one-enzyme"

In the wake of the discovery of the effect of Colchicine on chromosomes, work has proceeded on a wide sector on the effect of various alkaloids and other compounds on chromosomes. Interest has in recent years specially centred on chemical mutagens like mustard gas. Possibilities of the products of the plant's own metabolism inducing mutations have been investigated. The most interesting observation in the researches on mutagenesis is perhaps the specific action of different mutagens, some of the substances bringing about gene mutations, while others cause differences in chromosome arrangements; some affecting the heterochromatin, while others induce euchromatic changes. A new field has been opened up as a result of the development of atomic weapons and we may soon have information on the cytogenetics of plant material exposed to atomic radiations.

Induced polyploidy has greatly increased the possibilities and accelerated the pace of hybridization work. in plants. Although autopolyploidy by virtue of increased genomic complement confers benefits, within limits, in respect of increased size of plant and larger produce, such increases are associated with a marked reduction in fertility. Although the exact cause of such sterility are still somewhat obscure, the difficulty in autopolyploids has been partially circumvented by the use of hybrid material between near-races or products of cross fertilization in place of pure lines. The production of allopolyploids has gone apace and the discovery that many crop varieties and plant species are natural allopolyploids, has, as in many other fields of biological research, given a sound basis for further progress; for this means that whatever the methods adopted, the scientists' efforts parallel the processes of evolution in nature; only they are accelerated a million-fold and are to a large extent controlled and directed for the benefit of man. Findings on the genomic and chromosomal relationships between the related wild and cultivated species have led to the artificial synthesis of plants closely resembling existing species and varieties. In the cytogenetical work at our Sugarcane Breeding Institute, considerable knowledge has been gained on the homology of chromosomes as between sugarcane and allied species, and this has suggested possibilities of synthesising new types of cane.

Recent contributions in the field of biometry have greatly helped in the proper and accurate understanding of the laws governing heredity. Statistical methods now being generally used by agricultural research are applicable to discrete functions only. As Fisher has stressed, more refined methods for studying the variations in non-discrete functions like yield, chemical composition etc., should be adopted, since in plant breeding we are mainly concerned with the quantitative character, yield.

Plant Breeding: Remarkable advances have been made in maize genetics and, in general, plant breeding work has attained a high degree

of precision in the acquisition and incorporation of the desired genes in hybrid material. As a result, the value and utility of germ plasm of allied plants and related strains in plant breeding has enhanced greatly. This precision in breeding has been attained largely as a result of the work on different genomes and their combinations, as also from the investigations on monosomic and trisomic segregants. Unique hybrids in wheat and barley combining resistance to two or three types of rust have been produced, in some cases overcoming peculiar genetic obstacles.

The achievements of geneticists in the production of hybrid maize in U. S. A. are well-known. Although this technique of exploiting hybrid vigour is adaptable only to monoecious plants, attempts are being made to extend its benefits to other plants by the introduction of male sterility in pure lines. The scope of plant breeding has been extended through many fruitful investigations on the causes of sterility and parent incompatibility, and through the development of the techniques for the artificial culture of embryos. Genetics stocks are now being handled with such perfection and technical efficiency that crops practically 'tailored' to the local agricultural conditions and requirements can be produced; breeding of wheat varieties suitable for harvest by harvester-combines, and of cotton for the mechanical picking of bolls are just two examples.

Botany: The economic benefits of plant breeding are largely due to the collection, study and use of related plants in hybridisation; the assemblage of germ plasm in plant breeding centres has of late attained great importance. Genetic stocks have been collected through extensive expeditions, and important collections have been made of the germ plasm of potato, maize, sorghnm, cotton and other crops. In sugarcane also, a variety of wild types and species have been assembled, and we have at Coimbatore a large collection of *Saccharum spontaneum*, and scores of imported and indigenous canes, whose value as genetic stocks is being assessed. But apart from plant breeding, plant introduction by itself has played a great part in solving agricultural problems. There is now an increasing exchange of plant material between various countries, particularly in respect of plants suitable as forage crops and range grasses, of drought-resistant or winter-hardy crop varieties, and of soil-binding plant species. Botanical research bearing upon agriculture in certain directions has in recent years been influenced by new developments in taxonomic outlook. With the convergence of the branch-sciences of cytology, ecology, etc., on taxonomy, true phylogenetic relationships between different plant groups are being revealed. Studies have been directed towards evaluating intra-specific variution and understanding the dynamics of evolution. Experimental taxonomy using ecotypes and lesser climatic races of varions plants has adduced evidence on the fundamental basis of minor variation and explained the precise mechanism

of adaptation and natural selection in plants. Such studies on variation and adaptation in semi-cultivated range grasses, or wild species lead the way to better choice of material for purposes of introduction or for use in plant-breeding; they also help in more precise selections in progenies. Interesting progress has been made in this line of work on *Saccharum spontaneum* at the Sugarcane Breeding Institute, Coimbatore.

Plant-physiology: Rapid advances in our basic knowledge of photosynthesis have resulted from the development during recent years of highly refined methods of analysis. An important finding of immediate interest to us is that grain-filling in barley does not occur by the translocation of stored carbohydrates of the stem or leaf, and that photosynthesis of the green ear itself accounts for a sizeable proportion of the carbohydrates in the grain. Since grain yield is the most important factor in cereals, information on the assimilatory capacity of the green ear is of importance in varietal selection. The utilization of radio-active isotopes in plant physiological research has opened up immense possibilities. Release of the more stable radio-active carbon (C 14) in 1940 has helped greatly in the research on photosynthesis. Labelled nitrogen, phosphorous and other plant nutrient elements have aided in a fuller understanding of the factors and processes concerned in plant-nutrition. Investigations on the effect on plant yield of the interaction of various climatic factors has offered valuable information on the extent to which physiological adaptations may accrue as a result of the compensatory effects of climatic variables. Recent investigations on the mineral nutrition of plants have emphasised the role of light and temperature on the uptake and utilisation of nutrients. Day-length has come to be recognised as one of the factors concerned in the chemical composition and vitamin content of plants and plant products. Admittedly, these relationships are complex and the accurate measurement of climatic variables would help in the proper understanding of factors governing nutrition and crop yields.

As regards agricultural meteorological work, it may be said that detailed studies on the influence of weather conditions on crop yield are now being made for the past few years. Rate of development, number of leaves on plants and such other attributes have been correlated with weather conditions and form the basis for yield forecasts. These records further help us to pick out useful varieties and strains. Thus if we find that rainfall during a month affects the yield of a plant apparently because it retards leaf development, we can certainly select varieties in which the leaf development is not retarded by the adverse weather conditions.

Nevertheless, we must admit that these statistical methods of approach, however, useful, are rather empirical. For example, final yield

of a crop could be calculated by a series of statistical computations from the date at which the flowers appear. While we may satisfy ourselves by establishing an equation relating these two factors, we are unable to explain its physiological significance. It is necessary to understand as much as possible the inter-relation of the particular factors on plant development and final yield.

The discoveries of photoperiodism and vernalization of plants have inspired a large amount of experimentation leading to very important practical applications in agriculture. As a result of investigations at the Sugarcane Breeding Institute here, floral initiation has been induced in sugarcane by the application of short-day treatment.

It has been long recognised that the substance responsible for floral initiation is developed in leaves by the action of light; since this substance is subject to photosensitized destruction while in the leaf, it has to be transported to the stem in order to be effective. Graft experiments have indicated the identical nature of this substance in long and short day plants. Wavelengths ranging from 5,400° A to 7,200° A have been found effective in floral initiation, while the blue end of the spectrum is comparatively ineffective. The modifying influence of temperature on photoperiodism has been known for some time. A knowledge of the reciprocal influences between photoperiod and temperature is essential for evolving rational cultural practices.

Recent findings on vernalisation of developing embroys while still attached to the parent plants have a direct bearing on the seletion of areas for seed production and plant introduction. External applications of auxin have been successful in inducing flowering in certain cases and inhibiting it in other cases. While the differential response to auxin application has been made use of by growers, its physiology is not understood. The practical value to agriculture of major progress in this field is very great.

Following the classical researches of Went and Kogel on the influence of certain organic compounds on plant tropisms, a large amount of research on fundamental and applied aspects of auxins has been carried out. During the last ten years, new ways in which plants respond to growth regulators have been discovered. The effect of growth substances on the quality of plants and plant products may be stressed here. An interesting observation is that cattle sometime graze pasture plants sprayed with 2, 4-D in preference to unsprayed ones, and even browse on poisonous weeds which have been sprayed, although unsprayed, these plants would be avoided. The improved palatability may be due to the greater succulence of the treated plants and to the presence of larger amounts of sugars, unelaborated nitrogenous compounds, vitamins

and mineral salts in them. Plants treated with 2, 4–D are also more readily attacked by fungi. The direct influence of indole-butyric acid on the growth of fungi has been observed in *Fusarium.*

Agronomy: One of the most important advances in agronomy in recent years is the perfection of techniques of crop-logging through foliar analysis and other indices for purposes of fertilizer application and irrigation. Obviously, these techniques are not quite suitable for application to short life-cycle crops like cereals and are best used on crops like sugarcane where the harvest consists of the bulk vegetative parts of the plant and not the fruits or seeds. The development of weedicides I should place as the next important advance. Although these substances were not produced for this specific purpose, their use has come handy in the control of weeds at a time when soil physicists found that the utility of cultivation operations is not in the conservation of soil moisture but in the incidental destruction of weeds. As a result of the finding that chlorinated phenoxy acids had greater physiological activity, they have come into wider commercial use than Indole or Napthalene acetic acids. The mixture of two or more active compounds is said to be of value in certain applications. Mixed weed populations have been controlled more effectively by fortified oil emulsions.

The persistence of herbicides in soils has been studied in detail; the destruction of 2, 4–D has been found to be primarily due to the action of micro-organisms.

On fertilizers, one of the striking improvements of the past decade was in respect of placement. Studies have also been made on the differences in the degree of availability of nutrients in fertilizers under various conditions. Under march conditions in Cumberland, measurable differences were found in the oxidation-reduction potential of soils; oxidation took place at the soil-water surface but reduction lower down. The Japanese experts were the first to realise the bearing of these findings on the rice problem. They found that sulphate of ammonia put on the surface of field in the usual fashion at or before transplanting was quickly oxidised to nitrate which was promptly washed down and reduced to gaseous nitrogen. But, if sulphate of ammonia was pushed down through the oxidation-zone into the region of reduction, it lies there safely till the plant roots take it up. If nitrates like ammonium or sodium nitrate are added during the period of rapid growth, they can be absorbed quickly before they reach the reducing layer; therefore, they may be used as later top dressings. This is a very significant example of the far reaching results that may come from a purely academic enquiry. One of the best instances of the manipulation of fertilizer application technique is the recommendation that for increasing the nitrogen status

of the soil, leguminous green-manure crops should be fertilized with phosphates. Observations have been made on the perference of different crops to different forms of the same nutrient; liquid ammonia as a fertilizer, has come into fairly extensive use in the U. S. A. A recent far-reaching finding is that certain crop plants are capable of absorbing nutrients from fertilizer solutions sprayed on their leaves; fertilizer thus applied has led to improvement in the protein content or quality of the produce rather than in the yield. The greater efficiency of fertilizer when applied in this way is a further advantage.

Plant Pathology: Of the nearly 25,000 organic and inorganic compounds that have been tested for their fungicidal activity, only a few have been shown to be at least as effective as the orthodox Bordeaux mixture and the sulphur compounds. On account of the ease of preparation and application, several of these have been adapted to routine use. The demonstration of synergistic and antagonistic actions among fungicides and insecticides have raised problems in the application of new fungicides. The discovery of systemic fungicides is a recent and revolutionary development. These fungicides possess advantages over conventional fungicides in their effective coverage, efficacy against the hitherto intractable systemic diseases and in their non-interference with the natural balance in the shape of antagonists of plant pathogens existing on the plant surface. Antibiotics like penicillin, streptomycin, etc., which have proved themselves in the field of human medicine have been found useful against certain bacterial plant pathogens as well. The therapy of virus infection in plants is a recent development. Both heat and certain chemicals have been proved to be capable of curing certain specific virus diseases.

Entomology: While plant breeding has often given a helping hand in the evolution of pest resistant crop varieties, and still constitutes one of the principal means of combating insect pests, a more direct method with greater possibilities is perhaps the biological control of insects which has attained greater importance in application for agricultural purposes in recent years.

The most spectacular advances in pest control in recent years came with the discovery of the now well-known B.H.C. and D.D.T. While remarkable results have been achieved with these insecticides, and they have come extensively into general use, the possibility of the emergence of insect strains resistant to these insecticides has to be guarded against. Recently a number of other insecticides like Chlordane, Aldrin, have been put in the market which are proving increasingly useful. Mention should also be made of certain phosphorous compounds of great potency which are being developed as systemic insecticides. These may have particular value in the control of virus diseases transmitted by aphids

and other sucking insects. However, their effect on the plant and plant products as also on the consumer should be studied thoroughly before they can be put to regular use. Modern entomological research has progressed intensively in the direction of studies on population density, ecology and migration of insects, insect physiology and taxicology. These lines are bound to yield useful results of applicable value.

Need for New Values: This address has already become long and I think the above instances will serve to show to the young worker how the front in agricultural sciences has advanced and broadened. The need of the hour is not only for the agricultural research workers to change their mental outlook to one of service to the ryot, but also technically to equip themselves much better. This address will have served its purpose if it has emphasised ever so slightly and in its own humble way, the need for new values to the agricultural research worker. I cannot end better than by quoting the stirring words of our revered Prime Minister when he addressed a gathering at Dalhousie in the Punjab about a fortnight ago: "The time has come now for hard gruelling work. People with 'coat and necktie' mentality would hardly have any place in the new India."

JAI HIND.

LIST OF PAPERS RECEIVED FOR THE 37TH COLLEGE DAY AND CONFERENCE 1954

	NAME	SUBJECT
1.	Dr. K. C. Naik.	Recent advances in Agriculture — Introductory Remarks.
2.	Sri Ahmad Bavappa, K. V., and Srimathi Kalyanikutty, T.	A note on the sowing of Kolinji in standing crop of Paddy on the West Coast.
3.	Sri Anantanarayanan, K. P.	Recent Advances in Agriculture — Control of Insect Pests.
4.	Sri Aiyadurai, S. G.	Recent Advances in Agriculture, their potential importance to coconut industry.
5.	Sri Balasubramaniam, C.	Recent Advances in Agriculture — Meteorology.
6.	Sri Daniel Sundararaj and ,, Meenakshisundaram, D.	Recent Advances in Agriculture — Plant introduction and its further possibilities.
7.	Sri Kalyanaraman, S. M., and ,, Santhanam, V.	Recent Advances in Cotton Breeding Research in the Madras State.
8.	Dr. Krishnamurthy, S., and Sri Srinivasan, K. M.	Recent Advances in Agriculture — Growth regulators as Weed killers.
9.	Dr. Krishnaswhmi, N., and Sri Raman, V. S.	Recent Advances in Agriculture — Cytogenetics.
10.	Sri Kunhikoran Nambiar and Kumari Meenakshi, K.	Recent Advances in Agriculture — with special reference to the control of the root parasite Striga, affecting Sorghum.
11.	Sri Narayanan, T. R.	Recent Advances in Agriculture — with special reference to weed control.
12.	Sri Parthasarathy, S. V.	Recent Advances in Agriculture — with reference to Sugarcane in Madras State.
13.	Sri Rajagopala Ayyangar, T.	Recent Advances in Agricultural Chemistry.

14.	Sri Ramakrishnan, T. S.	Recent Advances in Mycology and Plant Pathology.
15.	Sri Ramaswami, K.	Recent Advances in Agriculture — A brief general survey with special reference to Rice.
16.	Sri Ranganathachari, N.	Recent Advances in Agriculture — Extension work.
17.	Sri Rangaswami, G., (Rutgers University, U. S. A.)	Recent Developments in the Chemotherapy of Plant Diseases.
18.	Sri Sarma, A. H. S.	Recent Advances in Agriculture — Fertiliser production and use.
19.	Sri Seshadri, C. R.	Recent Advances in Groundnut Growing.
20.	Sri Subramaniam, T. V	Plant Protection in the Madras State.
21.	Sri Varadarajan, S.	Recent Advances in studies on the Nutritive Quality of Staple Food-stuffs.
22.	Sri Venkatachalam, S., and Dr. Mariakulandai, A.	Recent Advances in the feeding of Plants.
23.	Sri Varisai Muhamad, S.	Recent Advances in Agriculture — with reference to Oil Seeds.

Symposium 'RECENT ADVANCES IN AGRICULTURE'

Introductory Speech by Dr. K. C. Naik, Headquarters Deputy Director of Agriculture, (R), Madras

The subject chosen for this year's Symposium is undoubtedly of utmost interest. It is, however, possible that as it stands, the subject may convey somewhat different meanings to different persons. It could, for instance, be all-embracing if we refer to the achievements in the agricultural field in all parts of the world. On the other hand, the connotation could be narrowed down to only the national sphere or to the Madras State alone or again to the particular line of work in which each of us is engaged. Thus, some clash of ideas is inevitable, though this need not be necessarily deprecated. Very often, such clashes of ideas generate sparks of new lines of thought to illumine the discussion and promote a more fruitful understanding of the problem.

Among the papers which have been contributed for the Symposium, it is possible, therefore, that there will be a considerable variation in the emphasis laid on the different aspects of agricultural work. Some may lay stress on the recent advances towards self-sufficiency in food production in this country; others may shift the stress on the enhanced production through a specialised branch of extension work, such as the popularisation of the so-called Japanese Method of paddy cultivation; yet others may refer to the progress made in the field of research in their own line or in the country or in the world at large. It is difficult to say that any one of these approches is unjustifiable. All have the same intent or purpose, of measuring the recent progress, from the view-point of accelerating the same.

Let me endeavour to review the recent advances with the hope of obtaining an overall picture of the situation, without restricting my attention to only one of these various approaches or fields.

Of late, there has been a claim that our country has attained self-sufficiency in the matter of food production. This is indeed a matter of supreme gratification, coming as it does after a long period of strain and stress. The question, however, may arise as to whether we will be justified in accepting this achievement as an absolute standard of progress. With agriculture depending on the caprices of the monsoon, the fluctuations in crop harvests are exceptionally wide from season to season, so that any sense of satisfaction over the food production figures of a season may possibly prove to be an illusion during an unkindly season. It is necessary to guard against any sense of premature satisfaction and to prevent this from being switched over to a deeper sense of frustration with the on-set of any adverse season. It is positively dangerous to get into a spirit of complacency and formulate our inferences and plans based on a favourable season's achievement. This is a word of caution which, I think, it is worthwhile to utter at this stage.

There are many who have drawn inspiring hopes from the popularisation of the so-called Japanese method of paddy cultivation in this country. It is even claimed that this, admittedly alien or outlandish method of farming, has already made us march appreciably ahead. So far as this State is concerned, the results of our experiments which have been carried over a year have not been uniformly in favour of the Japanese method. Till we have more definite evidence of the superiority of any new method over a series of years, comprising of good, bad or indifferent seasons, it is obviously unscientific as well as risky to apprise the value of that new method. The only suggestion that seems possible at present is that while there can be no objection for popularising the agricultural practises which have proved their value, whatever the names may be, it is definitely to our interest to go slow withthose methods whose only virtue is that they have been acclaimed to have given outstanding results under some conditions in some parts of this vast sub-continent.

Farmers, agricultural workers and scientists have all been of the view that the greatest single factor which determines the crop patterns of any given region or country is the environment. Modern agriculture has, no doubt, been shaped to a considerable extent by the efforts of the State to bring assured irrigation facilities to otherwise suitable but parched up lands. Whether it be the agriculture that is completely dependent on the vagaries of the monsoon or on the irrigation bounties provided by the State, which also is really dependent on the nature, it cannot be denied in the final analysis it is the environment which determines the shape of agriculture in any given land. When, therefore, we have to tackle a method imported from a foreign land, it is essential we should give it a thorough trial before we advocate the same to the farmers. Fortunately, in this State, we have taken abundant precautions in this regard because the so-called Modified Japanese Method of Paddy Cultivation which this department is advocating, is nothing more or less than the method which

we have tested under our conditions and found them as the most suitable. Experience shows that this very method of ours when put across to the cultivators under the cloak of a slogan is more effective than otherwise. Therefore, our campaign for Japanese method is not in any way conflicting with the spirit of scientific agriculture or with the practical requirements of our farmers.

Progress in the field of research has also to be judged with as much caution and circumspection. If, for instance, several millions of acres are being treated with 2-4 D weedicide in America or if Krillium is an invaluable soil conditioner in that country or if Folidol is a wide-spread measure of control against Paddy Stem Borer in Japan or if mechanised harvest of cotton is the rule in some countries, it is no argument that they should all be equally applicable to our conditions. As a matter of fact, our experience so far has been that 2-4 D is not an infalliable measure of weed destruction in this State, that Krillium if used here will increase the expenditure by nearly Rs. 300/- per acre per annum, that there are too many breeds of the paddy stem borer to permit the use of Folidol as an unqualified success, that with our cotton varieties hand-picking is the only method feasible at present.

From all what I have stated, it should be clear that the research findings or agricultural practices evolved or extant in one region, may have little or no value in another region. Our farmers cannot draw inspiration from the research findings at the Indian Agricultural Research Institute, New Delhi, nor from the farming practices followed in the Punjab or Bengal. We have to carve out our own salvation through our efforts and our research organizations in each of the various soil climatic zones of this State.

In this connection, it would appear that an objective examination to see how far our present day research organizations and methods to improve our agriculture are in keeping with our present day requirements, is very necessary. When this department was started, scientific conceptions and technique were in some respects as far removed from those of to-day as the shifting cultivation is from the modern mechanised farming. In fact, introduction of horse-drawn ploughs and hoes from the United Kingdom was considered as an effective means to improve Indian Agriculture in the days when the department was brought into being. Much water has flown since then and it may be very much to our interest to examine how best our organisation can be improved upon to render more effective service to the science of agriculture and to the farming community. Recent advances in Agriculture as are being reviewed to-day may be deemed as a milestone, to point out the way for further advances, by analysing our methods, technique and organisations; so that all of these may be improved upon, in order that they may be the instruments for real progress.

CENTENARY CELEBRATION, MADRAS STATE HERBARIUM

1853 — 1954

Welcome Address by Sri M. S. Sivaraman, I. C. S., Director of Agriculture

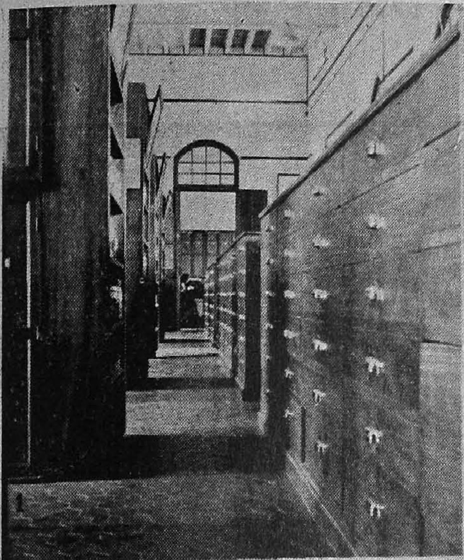
I consider it a great privilege to welcome all of you to this Centenary Celebration of the Herbarium attached to the Coimbatore Agricultural Research Institute.

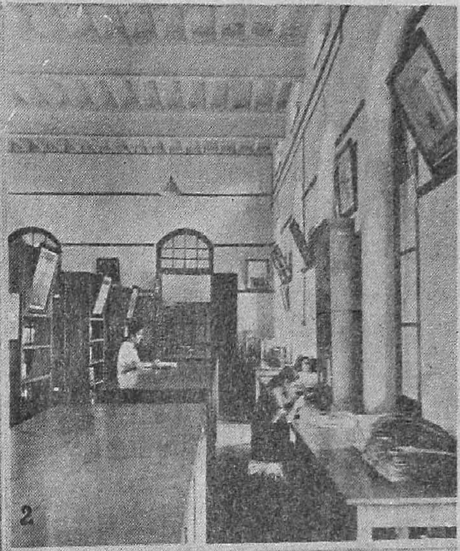
Our Herbarium had an uncertain origin prior to 1853 beginning with the private collections of Dr. Cleghorn, a Professor of Botany in the Madras Medical College and later a Conservator of Forests. It was at first an adjunct to the Madras Museum, in charge of the Government Botanist and with the change in the Headquarters of the Botanist, it was shifted to Coimbatore in 1909. Various private collections have helped to build up the Herbarium and these have been further augmented by botanical surveys of the flora of South India. It is now easily one of the largest Herbaria of India with over 1·7 lakhs of plant specimens of South India. Such a systematic repository of plant specimens is a great help in identifying plants and studying the distribution, potentialities and proper utilisation of the plant wealth of the country and it is a matter of great pride to us that this Herbarium serves as a clearing house of botanical information catering to the increasing demands of the general public, research workers and medical men. Among the pioneers who have been associated with this Herbarium, there were a large number of medical men and by a happy coincidence we have in our midst today one of the most distinguished of our medical authorities, Dr. A. Lakshmanaswamy Mudaliar. On behalf of the Centenary Celebration, I extend to you, Sir, a very cordial welcome.

Centenary Report by Sri C. Rajasekhara Mudaliar Systematic Botanist and Prof. of Botany, Agricultural College, Coimbatore.

Though the exact date or year when the Herbarium had its origin is not clearly known, it is definite that Dr. Hugh Cleghorn, the then Prof. of Botany at the Madras Medical College, was responsible for starting it. Specimens collected by him bearing the labels of Madras Museum Herbarium, 1853 show that it must have been started about that time. The nucleus materials were from the collections of Sir W. Elliot, Dr. Cleghorn and Dr. Drew about the year 1853. The collections were enriched by those of Col. Beddome containing 6,000 sheets. Then came George Bidie who made collections of medicinal plants and published a monograph on medicinal plants. In 1874 Prof. Lawson started another Herbarium known as Madras Herbarium and prepared a catalogue of plants growing in Madras Presidency. This included 3,295 species. Further contributions were done by Dr. A. G. Bourne and Dr. Edgar

MADRAS HERBARIUM





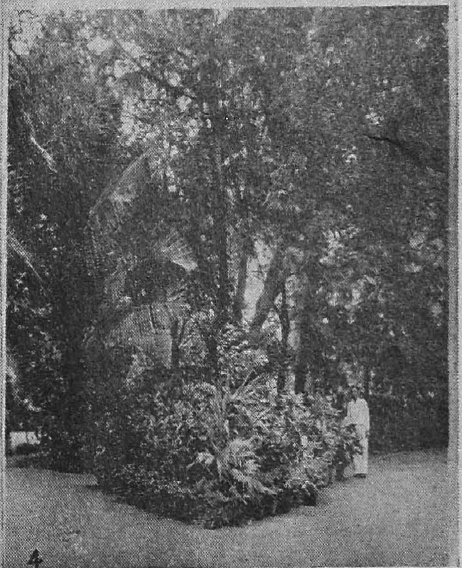


FIG. 1. Carpological cases.

FIG. 2. Laboratory.

FIG. 3. Herbarium cases.

FIG. 4. A view of the Botanical Garden.

HUNDRED YEAR OLD SPECIMENS

1853 — 1954

FIG. 1 FIG. 2

1. Guatteria longfolia. Coll. Dr. W. F. C. Cleghorn.

2. Guatteria suberosa. Coll. Dr. Elliot. 1853.

Thurston. From 1897 onwards Sri K. Rangachari was Herbarium-keeper at the Madras Museum Herbarium. The two herbaria seem to have become merged together at some time. In 1898 the herbarium came under Dr. C. A. Barber who was appointed as Government Botanist, Madras and Director of the Botanical Survey of S. India. When the Madras Agricultural Department was organised in 1902, the Office of the Government Botanist was transferred to Coimbatore in 1909, the Herbarium also was shifted to Coimbatore and is housed in the Agricultural College and Research Institute. Till about 1908 the herbarium had 40,000 specimens. Dr. Barber continued to be in charge till he was transferred as Government Sugarcane Expert in 1912. His collections alone exceeded 16,700 specimens of wild plants and 4,500 specimens of odd economic plants and mycological specimens. During 1912 the Government Botanist's post was split into the Government Economic Botanist and Lecturing Botanist. The latter was in charge also of Herbarium. Sri Rangachari was Lecturing and Systematic Botanist 1912 to 1923. He added to the wealth of the herbarium especially grasses and flora of Tirunelveli district. He published along with Sri C. Tadulingam the "Hand-book of some South Indian Grasses". C. Tadulingam Mudaliar succeeded Sri Rangachari.

From 1929 to 1942 the Madras Herbarium passed through several administrative hands like Sri V. Narayanaswami, P. Jivanna Rao, S. N. Chandrasekhara Iyer etc. The Madras Herbarium through the labours of the above workers and assistants has grown to possess nearly 1,70,000 specimens, representing the flora of Madras Presidency including Mysore, Coorg, Cochin and Travancore, some specimens representing North India, Burma, Malaya, Ceylon and other foreign countries and also specimens of garden and economic importance. These specimens were sent from time to time to and got authenticated by Kew. They were utilised by Gamble in the compilation of the Flora of the Madras Presidency. Since then the general arrangement of the sheets follows Gamble's so far as Madras is concerned and North Indian specimens according to Hooker's classification. The Herbarium now contains the very valuable collections of Wight, Beddome, Bourdillon Gamble, Hooker and Thompson, Perrottet, Heyne, Rottler Schmid, Jowitt etc. Besides these there is also a large carpological and seed collections. The library attached to the herbarium contains also the rare and earlier publications on Systematic Botany of Linnaeus, Willdenow, De-Candolle, Engler and Prantle, Rheede, Rumphis etc. Besides the publications mentioned a survey of South Indian weeds was published by C. Taduligam and G. V. Narayana. The work continues to be on both economic and academic lines. Fresh surveys both regional and general have been going on. As an adjunct to the Herbarium is a small Botanical Garden which now serves also on a minor scale as a plant introduction and acclimatization centre.

Introductory Speech by Sri M. Bhaktavatsalam, Minister for Agriculture, Madras

Friends,

We are met here today to celebrate the Centenary of the Madras State Herbarium which is reputed to be the second best in India. Beginning originally as a small collection of plants in the Madras Central Museum in 1853, it was continuously enriched by successive generations of botanists, so that it now contains over 1,70,000 specimens representing the flora of South India and about 25,000 specimens representing the flora of North India. We must be proud that the Herbarium has now completed 100 years of its useful existence and on this occasion we should render tribute to Dr. Hugh Cleghorn, Col. Beddome, and Dr. C. A. Barber and others who laboured in the earlier years and to eminent botanists like Sri K. Rangachari, Sri C. Tadulinga Mudalir, Sri P. S. Jeevanna Rao, Sri S. N. Chandrasekharan and others who developed it subsequently.

The Herbarium has gained a fine reputation in the field of systematic botany through its publications like the Handbooks on South Indian weeds and grasses and supply of information to enquiries from various quarters and hence it is a great national asset. Those to whose care it has now been entrusted and will be entrusted in the future should deem it their privilege to preserve and enrich the fine collection of specimens and to make it serve more and more its purpose as a clearing house of botanical information and thus help in the proper utilisation of the plant wealth of the country.

I feel that there is considerable scope to expand the usefulness of the Herbarium in the agricultural, pharmaceutical and industrial fields. The flora of our State which covers a wide range of altitudes and regions from the sea coast to the highest peak of the Western Ghats is infinite in its variety and there is vast scope for work for the Botanists for their identification, classification and economic exploitation. The identification of new plants and their putting to uses hitherto unknown has a wide possibility of striking new lines in agriculture. The Forest and Medical men will also need consultation in the matter of identification of plants in many matters. The Botany departments of the Universities will also have the benefit of the classified knowledge available in the Herbarium which, if I may so put it, is a library of plants. Our country is well known for its indigenous systems of medicine like the Siddha, Unani and Ayurvedic, in which medicinal plants have played a very important part. Even in other systems, plants still continue to be the primary sources for many of the products that are necessary in treating the sick and the ailing. For example, there is at present said to be a keen demand for the roots of *Rauwolfia serpentina* in foreign

markets for the preparation of drugs for epilepsy and similar diseases. The chief source for this plant is South India. Unfortunately with increase in demand, spurious and adulterated materials also get into the market. There is another species of *Rauwolfia* - *R. canescens* occurring in certain places, which is very similar to *R. serpentina*. Studies on their distribution, quality of the active drug in each and the possibilities of multiplying the plant are a few of the points that could be taken up with the help of this Herbarium.

I understand that the herbarium staff have taken up the preparation of regional floras. The flora of Tirunelveli district have been completed and the flora of the Ramanathapuram and Coimbatore districts are in the process of compilation. Such regional surveys are very important. In this connection, I may mention that it is stated that the medicinal properties of the waters of the Courtallam river might be due to the effect of certain drug plants occurring in the areas through which the river flows. I do not know whether the drug plants growing in those areas have already been collected. Similarly the breeze wafted over the plants and herbs on the hill at Tirukalikundram is well known to have health-giving effects. A survey of such plants would be useful.

I am very happy that Dr. Lakshmanaswami Mudaliar has kindly agreed to preside over the Centenary. It is in the fitness of things that an eminent medical authority and the Vice-Chancellor of the University should be associated with this Centenary. It will be remembered that the nucleus of the present Herbarium was collected by Dr. Hugh Cleghorn who was Professor of Botany in the Madras Medical College and medical men have evinced keen interest in the utilisation of the flora of this State. It is also a happy augury for the researches at the Universities will be linked up with the work done by the Government Department of Agriculture and the Agricultural College. I am sure we will profit by the ideas and advice which Dr. Lakshmanaswami Mudaliar will be able to give. I have now great pleasure in requesting him to deliver his address.

Address by Dr. A. Lakshmanaswami Mudaliar, Vice-Chancellor, Madras University

Ladies and Gentlemen,

I am deeply sensible of the honour you have conferred on me in asking me to preside over the centenary celebrations of the Herbarium. It is but fitting that this centenary should be celebrated at Coimbatore, one of the earliest centres for the development of higher agricultural education. Coimbatore was in the past known more for its pleasant climate throughout the year and for the great leaders in different fields social, political and economic activity in the State. But, within the last

twenty years, a silent revolution has taken place and, today, Coimbatore is one of the most advanced cities in India — advanced in regard to its technological, educational and social progress. No other city presents in a like manner a combination of all these great activities to the extent to which Coimbatore does. The progress that has been made in regard to the textile industry is indeed remarkable and, today, if South India can boast of a textile trade which places it more or less on an independent basis, it is because of Coimbatore and a few other centres.

But the progress that I have in mind as truly remarkable is in the direction of its educational activities, thanks to the enlightened policy pursued by its leading citizens. It was barely twelve years ago that I visited Coimbatore to consider the possibilities of upgrading a small tottering second-grade college in this city. And when I look back upon the progress of education in the last twelve years, I am overjoyed at the many institutions that have sprung up. A college of engineering, a polytechnic, a first grade college with arts and science equally developed, a women's college, a college of technology founded by private benefaction, another college with potentialities of great improvement, not to speak of a thriving agricultural college ; these are not mean achievements for any city within a decade. But it is not only in the educational endeavours that the citizens of Coimbatore have shown their philanthropy. Here, I have seen real and sustained enthusiasm to bring into existence many a medical institution. The women and children's hospital, the tuberculosis sanatorium and the tuberculosis annexe of the Government Hospital, not to speak of other smaller institutions that have sprung up, are an eloquent testimony to the public spirit of the citizens of Coimbatore. When, occasionally, a jarred note is sounded and a carping critic speaks of the wealth of the mill-owners of Coimbatore, I feel that it would be gross ingratitude to forget the other side of the picture and not to take account of all that has been done and is being done. But they say that gratitude is a sense of lively favours yet to come and I agree that, so far as Coimbatore is concerned, my sense of gratitude, if I may unblushingly confess, is a lively sense of favours yet to come. I am sure that the public-spirited citizens of Coimbatore will not be providing greater and greater amenities in all spheres of social service not only to the people of Coimbatore town but to the people in general of the District, aye ! of the neighbouring Districts.

My purpose today however is to speak about the Herbarium and, if I may be permitted to say so, to say a few words about the Agricultural College and the progress of agricultural education in general. We owe this Herbarium to a number of eminent European scientists who, with rare foresight and determination, exercised their very best to collect all these specimens of the flora of this part of India and to make a beautiful Herbarium for posterity to benefit. I am glad however that

the coutributions that have been, made by successive generations of Indians have, been no less remarkable. Few perhaps are aware of the importance of a Herbarium. It is a matter for regret that not much attention has been drawn to this particular aspect of the development of agriculture in its broadest sense. We are not in a position to know exactly, even after so many centuries, what the agricultural resources of our country are. There was a time in the past when the village folk and even the so-called town folk knew far more of the plants, of the varieties of grass, of the different kinds of trees and what is far more important of those plants that were used for the production of drugs for many diseases. It is unfortunate in one respect that the easy availability of medicines manufactured in the West has dulled our sense to a better realisation of the resources of our country and to the proper utilisation of the many plants that can serve as excellent material for the production of drugs, so very useful to promote health and to prevent disease.

It may surprise some of you to know that the recent trend in medical advance is more towards relying on herbs and what may be called the lowest forms of vegetable life. How many of the audience, for instance, are aware of the fact that the most potent remedy for infection, penicillin, was just an accidental discovery by Fleming when he cultivated some of the lowest types of vegetation. Every effort is now being made to search for these lowest forms of vegetable life and to note their potentialities in the killing of organisms which, though minute and almost ultra-microscopic, are the greatest dangers to human and animal existence. It is therefore my hope that the centenary of the Herbarium will once more kindle in the minds of all botanists and other scientists an interests in the study of plants and other vegetable life and the part they play in preventing the spread of microscopic and ultra-microscopic infections. But this knowledge will be useful not only in regard to prevention of diseases in the human and animal life but, what is perhaps not so commonly understood, it will have a potent influence in the promotion of the healthy growth of vegetable life and the prevension of some of those unfortunate pestilential organisms that devastate large areas of budding crops.

Speaking under the auspices of the Ministry of Agriculture, let me next refer to a point which I feel has received very little attention indeed. When we speak of agricultural education in the State, let me frankly confess that most people will have the impression of the type of education that is given in the Agricultural College here. I have myself raised my feeble voice of protest that this education that is imparted does not promote in the students, who pass out of this College, those inherent inclinations and qualities which will force them to take to agriculture as a career. I think it was one of the most unfortunate trends in the sphere of agricultural education when, through a mistaken notion of

State patronage, graduates of Agricultural Colleges were given employment in diverse fields. I cannot imagine a more wasteful method of professional education than to allow a graduate in agriculture to be recruited as a clerk in the Revenue Department or as an officer in the Transport Department, not to speak of more bizarre types of employment. If only the Government, at an earlier stage, had firmly insisted upon agricultural graduates turning their attention to the plough and not to the pen, agricultural education would have taken a practical turn and the graduates turned out of Agricultural Colleges would have had a better opportunity of utilising their knowledge and training in the furtherance of agriculture. I hope it is not too much to ban all agricultural graduates from taking to these diversified forms of employment which have nothing to do with their education. It will shock many if a graduate in medicine takes to the work of an upper division clerk in a Government Office. I do not know how the idea of a graduate in agriculture quill-driving in a governmental office amidst damping surroundings could be less shocking. But the defect in agricultural education is even fundamental. No type of education has received less attention than agricultural education in regard to equipment in the field of agricultural enterprise. There is a great deal of talk and the cry is voiced far too frequently; "Go back to the land." But the very people who are loudest are those who have little or no faith in the slogan. This difference between what we preach and what we practise was brought home to me when, as Chairman of the Secondary Education Commission, I went round the country and saw the state of agricultural education elsewhere. In a few places in the north of India, there were the so-called agricultural schools; but the depressing sight of the students taking to this education as if they were taking a bitter pill will never efface itself from my memory. If agriculture is to develop, if there is to be a real zest in the development of the land, and if more modern knowledge of agriculture is to spread, the place to begin agricultural education is from the earliest stages of development.

Our farmers' children were far better educated because of their practical application to the problems of the land along with their parents than the children sent to schools nowadays are. It is shocking that in the cities and even in certain of the rural areas, children and the school-going population and even adults know very little of the crops that are raised and are unable to differentiate between one crop and another in a large field. It is for these reasons that the Secondary Education Commission has emphasised the need for the study of agriculture at the secondary school stage. It is for these reasons that they have suggested that, for many a school, a plot of land should be given where the pupils and the teachers may throw their energies into the development of that land and in that manner learn something of agriculture. Unless therefore, the Government takes up measures, not in isolation here and there

in a few places, but as a concerted planned method of developing agricultural education in as many schools as possible, particularly those situated in rural areas, there is very little possibility of real progress being made in the field of agricultural education.

We speak very often of the great progress made in countries like the United States and Japan in agricultural production; but we do not realise that this production was the result of development of agricultural education to all grades and in all sectors, not merely in schools and colleges but in the homes of the farmers so that the very life of the farmer is permeated with the latest and most recent advances in agriculture. Not only is this the case but, in the United States, sums of money have been given for the development of agricultural education; funds have been placed at the disposal of schools and colleges; farmers societies have been established; competitive enterprises have been organised; and, in many other ways, the federal government has come to the assistance of the agriculturists in speeding up many an agricultural enterprice. Let me however be not misunder-stood as being ignorant of the great endeavours that have been made in recent years in independent India. We have had some progress but is it commensurate with the need of the times nor with the possibilities of the great developments in this field.

Let me touch upon another aspect of agricultural advance. Research is the key to all agricultural development and, if research is to succeed in agriculture, it must be planned on a largely co-operative basis with many other scientific activities. To-day, the remarkable advances in science are so staggering in their nature and so full of possibility for every other branch of development that no particular branch can afford to stand in isolation. Agriculture, like medicine, should be both a parasitic and saprophytic agent. The discoveries in physics, in chemistry, in geology, in the many fields of zoology and botany, are all matters of concern to agriculture. The very atomic energy, that causes consternation in the minds of many at the very thought of its devastating effects, is a source of energy which can be harnessed for productive wealth. I cannot with any degree of varacity say that, good as the work has been in our Research Departments, there has been either enough progress or enough encouragement in the field of agricultural research. What have we been able, within the last fifty years, to show that new forms of vegetation can be grown successfully in our country at different altitudes? What substantial progress have we made in the direction of analysing the nature of the soil and the factors that contribute to the proper growth of plants? What measures have we taken for research in regard to high altitude plant life? And yet, in India, nature has blessed us with a climate which can, at one place or other, simulate the arctic and the antarctic cold, the blasting heat of the tropical sun and the more

pleasant and even temperate zone: Which country in the world possesses all these great advantage? Mighty rivers that flow through our plains, the high altitude mountains from the great Everest down to the smaller hill stations in the south of India. Has the agriculturist done anything material to discover the possibilities of new vegetation at these different altitudes. It is this thought that has recently provoked the University of Madras to think of establishing a high altitude botanical research station and it is with this hope that the University has addressed the University Grants Commission for a grant to start a botanical research station at Kodaikanal where the soil, its fertility and the nature of plant growth that can be established can be studied at varying altitudes between 3,000 to 8,000 feet above sea level. I have no doubt that some of these problems will appeal to our Government but we must educate our masters and educate them in such a manner that they are fully equipped with the knowledge without realising that they are being silently educated. That is one of the fundamental problems of educating a democracy. A democracy resents the idea, when it is put plainly, that it has to be educated but the silent manner in which those who know the subject and are conversant with the methods of approach can educate will certainly go far to make democracy realise in the long run that there are many things in heaven and earth than have been dreamt of.

I do not want to tire your patience; but, when I look back to what has been done during the past hundred years and when I look forward with hope, eagerness and longing to a throbbing flourishing India on the threshold of great potentialities, when I look to the millions of our countrymen who in the free and independent India that is theirs are hoping for the miracles to happen without realising in a sufficiently intensive manner that hard work, incessant work and laborious work are the only factors to produce miracles; when I think of the easy platitudes that are spoken on platforms of the hardships of this or that class of people and the unfortunate trend of the concept that duties and responsibilities go always hand in hand with rights and privileges; when I think of all these things, I feel sometimes very much obsessed with a feeling of intolerable depression. Every time that I have had the opportunity of going to foreign countries, seeing something of what is happening there—at least in most of the countries—look upon the life of the people there, the hard untiring labours through conditions, climatic and otherwise which are far from congenial, when I come back and see the almost snail like progress which we sometimes make in many fields, I confess to a feeling of great dejection. Yet, there is hope and hope springs eternal in the human breast.

I believe, and fondly, that to-day there is a greater inclination among our countrymen, among the youth in particular, to play their role given the proper encouragement, given the proper guidance and

given the right advice. Nothing will conduce to success in life so much as a spirit of discipline and orderly life and it is my hope that we shall, now that we are entering on the eighth year of independence, realise that the true welfare of our country, of the masses, lies not in speaking eternally of a welfare state but in doing something tangible, something which has earned its due reward whatever may be the role that we may have to play. I hope and trust that the celebrations of the centenary of the Herbarium will serve as a great energising force not only for the Department of Agriculture and the Agricultural College here but for the Government, the Ministers of the several Departments and their Secretaries as well and to the large number of legislators and the general public, to take a keen and abiding interest in the furtherance of agricultural education of the true type and in the development of the many great natural resources which God and a kindly Nature has furnished us.

Vote of Thanks by the Principal

Dr. A. Lakshmanasami Mudaliar, Hon'ble Minister for Agriculture, Ladies and Gentlemen,

As the Principal of this Institution, it is my privilege to propose a vote of thanks. We are very grateful to Sri A. Lakshmanasami Mudaliar, Vice Chancellor, Madras University for having accepted the invitation to preside over the centenary celebrations of the Madras Herbarium. On behalf of the officers of the Agricultural College and Research Institute, Coimbatore I congratulate and offer the warmest felicitations on the conferment of the title 'PADMA VIBUSHAN' on the distinguished President of today's function. I need not add that not only the State but the entire country will feel proud of the honour conferred on him on the Independance Day. The hundred years which have passed since Dr. Cleghorn made the first collection to form the nucleus of the present herbarium, have witnessed not only a very rapid expansion due largely to the enthusiasm and sustained contributions made by the successive Botanists attached to the Agricultural Department from the year 1898 but has also earned recognition of famous Botanists in Kew and other countries. The Botanical Section is a treasure house of recorded in formation on plant wealth of South India, and the survey of grass species undertaken by them has been very useful in developing types suitable for fodder, pasture and soil conservation work. Let us wish the section a long period of usefulness, service and progress. On behalf of the organisers of this function, I take this opportunity to thank all the invitees for having responded to the invitation and for having contributed to the success of the celebrations.

General Body Meeting

The annual general body meeting of the Union was held on Sunday the 22nd August at 9-30 A. M. with Sri R. Balasubramaniam ex-officio President in chair. After the presentation and adoption of the minutes of the previous general body meeting, annual report and the auditor's report the following office-bearers were elected for the year 1954—55. Sri M. R. Balakrishnan declared that he would become a patron of the Union.

Sri R. Balasubamaniam	Ex-officio President.
Dr. N. Krishnaswamy	Vice-President.
Dr. A. Mariakulandai	Editor.
Sri F. L. Daniel	Secretary.
Sri N. V. Sundaram	Manager.
Sri M. V. Jayaraman	Treasurer.

The members of the council, both residential and moffusil, managing committee and editorial board were duly elected. The meeting came to a close with a vote of thanks proposed by Sri A. Mariakulandai.

Report of the Managing Committee for the year 1953 — '54

The Managing Committee presents the following report of the activities of the Union for the year 1953 — '54.

Membership: The strength of the Union as it stood on the 31st of July 1954 was 1144 as against 1450 of last year consisting of 455 Officer members, 294 Student members, 150 Residential Members, 245 subscribers and 23 Patrons. Consequent on the division of the Madras State, 273 members in the Andhra State, 16 in the Mysore State and all the Students of Bapatla Agricultural College have disassociated themselves from this Union. The number of members on the roll of the Union is, therefore, poorer to that extent. The Committee urges all those present here to launch an intensive campaign to enrol as many members as possible.

Office Bearers: Sri T. V. Subramaniam, our Manager, had to resign his post prematurely due to his transfer to the Nilgiris. The Committee records its appreciation of his services with thanks, during the period he officiated as Manager. On his resignation, Sri K. Ramanujam was co-opted as Manager.

Meetings: During the year the Managing Committee met 12 times, to transact the routine items of business.

The Madras Agricultural Journal: The Journal continued to be published regularly and promptly due to the untiring efforts of the Editor,

the Editorial Board and the Press to whom the Committee tenders its heartfelt thanks. The Editorial Board met 11 times during the year to select articles for publication. The papers received for the Symposium held during the College Day and Conference in 1953 are to be published as a special number which is pending the financial sanction of the Government.

Finance: The financial position of the Union is not very sound. It has deteriorated since the separation of the Andhara State. The Managing Committee has tried all possible means to improve the finances through recruitment of more subscribers and Patrons.

The Managing Committee has approached the I. C. A. R. for an yearly grant of Rs. 2000/-. The District Market Committees have placed funds at the disposal of the Union to the extent of Rs. 400/- annually for printing a 5 page "Marketing supplement" in the Madras Agricultural Journal. It is left to the General Body to suggest other ways and means of improving the finances of the Union so as to bring out our Journal with all round improvement in the years to come.

Ramasastrulu Munagala Prize: Three papers were received for consideration for the prize. The papers were valued by a Committee of three Judges nominated for the purpose. The paper entitled "Enzymatic Studies of *Aspergillvs Oryzae*" was awarded the prize. The Committee congratulates the winner Sri S. Varadarajan of the Chemistry Section and thanks Dr. G. S. Siddappa, Dr. P. Satyanarayana and Dr. S. Krishnamurthy for kindly acting as Judges. Sri K. Vekitaswamy Naidu gave a silver medal for the second best essay, for this year.

Acknowledgement: The Committee thanks the members of the Union and the Students of the Agricultural College for their whole hearted support given in running the varied activities of the Union successfully. Our thanks are due to Sri R. Balasubramanian, Principal, Agricultural College, Coimbatore for his keen and sustained in interest in the affairs of the Union. We have also very great pleasure in recording over thanks to the convenors and members of the various Committee for their whole-hearted co-operation and help in the conduct of the College Day celebrations.

A. Mariakulandai,
Honorary Secretary.

Farmers' Day Celebration

The Farmers' Day celebrations were conducted on the 19th forenoon at the Central Farm. A large gathering of farmers, officers, visitors and Farm labourers attended the meeting. The entire proceedings were conducted in the regional language.

The Principal, Agricultural College and Research Institute after welcoming the Minister for Agriculture, Madras State, Farmers of Coimbatore district and other visitors stated that it was in 1950 on the instructions of the Director of Agriculture these celebrations were first arranged and thereafter became an annual feature of the Department. The purpose of these celebrations was to popularise the activities of the Department, and to include in the programme exhibits for bringing out the various attainments, demonstrations of improvements in field and talks by specialists on scientific problems of the tract. Such celebrations were considered as necessary and indespensable activities of the Agricultural Department not only for disseminating the latest finding in actual cultivation, and be useful in exchanging notes with visiting farmers, in understanding their difficulties to implement the suggestions of the Department and in eliciting information on other urgent local problems. He stated that during the year, the Central Farm produced and supplied for distribution in the districts 40 tons of improved varieties of paddy seeds, 50 tons of seed millets and seeds of MU 1 cotton sufficient to cover 700 acres of seed farms. Beside the above, the farm was able for first time to offer for sale 60 tons of surplus fodder after reserving the requirement for the whole year. It was not only self-sufficient in regard to its own requirements of green manure but also supplied seeds to cultivators and district officers. He said the notable features of the exhibits arranged include 1. the new paddy variety resistant to blast, 2. the short duration P. 216 F cotton fit for cultivation on rice fallows of single crop wetlands of Coimbatore district, 3. short duration hybrid cumbu H. 866 suitable for irrigated summer, 4. the solution to the green manure problem of rice crop and 5. the bullock driven double acting pump for lift irrigations. This year he said that the Young Farmers' Course was in session and has given them an opportunity to take part in the College Day functions and Farmers' Day celebrations.

Several farmers spoke of their experience and replies were given by the specialists. After a vote of thanks the meeting ended with singing of National Anthem.

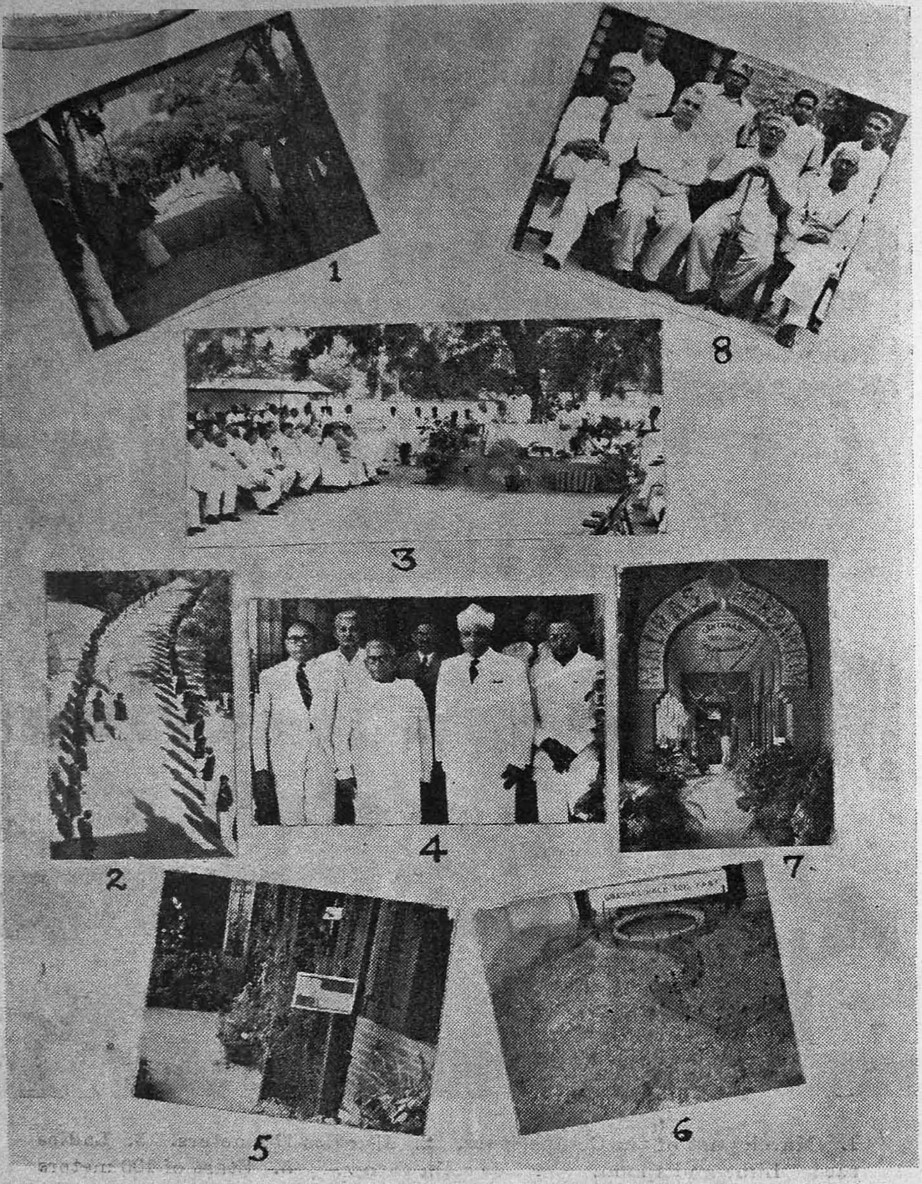
RESULTS OF COLLEGE DAY SPORTS

1. CROSS COUNTRY RACE (5 miles) THE NORRIS CUP. (36 min. 13 sec.) (1) N. K. Periaswami, (2) J. M. Alfred, (3) T. L. Subramaniam. 2. POLE VAULT (8 ft. 0 in.) (1) Gadadharan, (2) Javad Hussain, (3) Jagadeesan. 3. 110 METRES HURDLES (THE RAMASWAMI SIVEN CUP) (20 sec.) (1) Javad Hussain, (2) Marappan, (3) Sankaran. 4. SHOT PUT (31 ft. 2 in.) (1) W. Odongo Omamo, (2) Dharmaratnam, (3) Tie. D. V. Viswanath. 5. 100 METRES DASH (THE SAIDAPET OLD BOYS CUP) (11 4/5 sec.) (1) K. Marappan, (2) P. K. Ramakrishnan, (3) Premnath Alwa. 6. LONG JUMP (16 ft. 10 in.) (1) Kochunni Kidav, (2) G. A. Sivaraman, (3) S. V. Ponnuswami. 7. 200 METRES HURDLES (30 sec.) (1) Marappan, (2) P. K. Ramakrishnan, (3) P. Shivaram Rai. 8. HIGH JUMP (THE TADULINGAM CUP) (5 ft. 2 in. equals college record) (1) G. A. Sivaraman, (2) Kochunui Kidav, (3) Saldanah, 9. INVITATION RACE (800 Metres) (1) K. Ramaswami, (St. Michaels), (2) Joseph Varkey (P. S. G. Technology), (3) V. Arumugham (P. S. G. Arts), 10. HOP STEP AND JUMP (35 ft. 8 in.) (1) G. A. Sivaraman, (2) P. K. Ramakrishnan, (3) Navakote.

COLLEGE DAY SPORTS

1. March past of the Competitors. 2. Hurdles 110 meters. 3. Ladies race. Lime and spoon. 4. Javelin throw. 5. Start of 100 meters dash. 6. Obstacles race. Tackling the lemons. 7. Pole vault. 8. High jump. 9. Elders competition — tailing the elephant. 10. Victory stand. Winners in the lime and spoon race. 11. The Director of Agriculture giving away the Championship cup to M. Marappan. *(Photos courtesy of Stephen Dorairaj and P. N. Sundaraswamy).*

COLLEGE DAY CONFERENCE



1. College portico decorated. 2. Guard of Honour by the students. 3. Farmers' Day Celebration. 4. Centenary Celebration left to right: Director of Agriculture, Principal, Minister for Agriculture, Deputy Secretary, Government of Madras, Vice-Chancellor, University of Madras, Systematic Botanist and Professor of Botany, and Head-quarters Deputy Director of Agriculture (Engineering), 5, 6 and 7. Exhibits of the College Day, 8. Managing Committee: Sitting – A. M. Kulandai, N. Krishnaswamy, M. R. Balakrishnan, C. S. Krishnaswamy. Standing – Varisai Muhamad, T. S. Lakshmanan, M. V. Jayaraman, N. Ranganathachari.

11. 400 METRES RACE (PRINCE OF WALES CUP (56 4/5 sec. New record), (1) Marappan, (2) T. L. Subramaniam, (3) Premnath Alwa. 12. JAVELIN THROW (102 ft. 2 in.) (1) G. C. Perumal, (2) P. Shivaram Rai, (3) W. O. Omamo. 13. 1,500 METRES RACE (1 Mile Race) (5 min. 2 1/5 sec.) (1) N. K. Periaswami, (2) Meenakshisundaram, (3) Kadambavana Sundaram. 14. STAFF RACE (100 Yds. Race (10 2/5 sec.) (1) Ratnam, (2) Chandi, (3) Shetty. 15. OBSTACLE RACE (1) S. Sankaran, (2) Abdul Latif, (3) Perumal Raja. 16. DISCUS THROW (79 ft. 2 in. New record) (1) G. C. Perumal, (2) W. O. Omamo, (3) D. V. Viswanath. 17. 200 METRES (25 sec.) (1) Marappan, (2) G. A. Sivaraman, (3) Premnath Alwa. 18. OLD BOYS COMPETITION (Tailing the Elephant) (1) M. R. Balakrishnan, (2) M. A. Sankara Iyer, (3) Raman Menon. 19. WOMENS' RACE (Lime and Spoon Race) (Women only) (1) Miss Sukanya Bai, (2) Miss Savithri. 20. HAMMER THROW (70 ft. 6 1/2 in.) (1) W. O. Omamo, (2) Dharmaratnam, (3) S. Sankaran. 21. TREASURE HUNT (1) Kandaswami Gounder, II year, (2) Surendran Bhagavathiappan (Tie). INTERWARD TUG OF WAR (1) S. M. Kalyanaraman, (2) S. Reddy. INTERWARD RELAY RACE (1) Entomologist, (2) A. H. S. Sarma, (3) Civil Engineer. CHAMPIONSHIP CUP Sri K. Marappan.

EXTRACTS AND GLEANINGS

Chinese Science Revisited (2). Dr. Joseph Needham, F. R. S. Nature Vol. 171 : No. 4346, 14th February 1953, Page 283 - 85 : At the end of the last article there was mention of geological survey parties — eighty-three of these were in the field during 1951. But the Geologists have also given essential service in the physiotopographical surveys of areas where railway construction and river conservancy work are progressing. Without them the Lunghai railhead would not have reached Lanchow ten months ahead of schedule, as it did ; without them the astonishing progress could not have been made with the Huai River Project. In this scheme, which will solve the problem of a great river (between the Yangtze and Huang Ho) for generations to come, sixteen large retention-basin dams are being constructed on the upper tributaries in the provinces of Honan and Anhui. Some are already finished and the whole project will be at least on the scale of the famed Tennessee Valley Authority.

In other cases, parties of scientific men of very varied specialities have taken the field. For example, a party of no less than fifty experts proceeded to Lhasa to see what could be done to assist the Tibetans in improving their condition of life. This group included agronomists, soil scientists, geologists, geographers, meteorologists, sanitary engineers and medical men, ethnologists (for example, Li An-Che) and historians. Another large party, including gynaecologists and child welfare experts, visited the minority peoples of Sinkiang.

The current emphasis on practical tasks can be seen in all fields. In some, the results produced can be spectacular. The cotton aphid (*Aphis gossypii.* Glover) has long been a great pest in the cotton growing regions of southern Hopei and the newly formed province of P'ing-Yuan. But its life-cycle was not well understood. After several months of travel and research in the regions concerned, Chu Hung-Fu and his colleagues of Academia Sinica were able to ascertain that this aphid passes the winter attached underground to the roots of a common weed *Lactuca* or *Ixeris chinensis versicolor.* It is now possible, therefore, to eradicate it almost completely ; this is all the more important a discovery because the pest is rather resistant to known insecticides. While I was visiting the Academy's Entomological Laboratory, reports came in of the first successful large-scale use

(1951) of gamma benzene hexachloride against locusts, spread from aeroplanes in southern Hopei and Anhui. Many of the new substances for insect control, such as E, 605, 666, 'Gammexane', etc., are now made in China.

As for the emphasis on teaching, it can be seen in all fields. For the time being, research is concentrated rather in the institutes and laboratories of Academy, though it goes on to a minor extent in university laboratories; this is regarded as a passing phase, for the general principle that the latter should also be active research schools is fully admitted. Planned expansion in geology, for example, is remarkable – where there were 35 students in 1951, there were 120 last year, and for this year 1,000 are being planned for. The Medical College of Peking University, and the National Medical College at Shenyang (Mukden), formed by the additional absorption of the former Scottish and Japanese schools, are indeed impressive in their size and vitality. According to Dr. Hu Chuan-Kuei, principal of the Peking University Medical College, which has forty years of history, the student numbers rose from 400 in Komintang times to 1,400 at the present day. This includes 260 students in pharmacy, 160 in dentistry, 140 in public health, 40 in nursing and 40 in midwifery. The total number of qualified medical men in China is of the order of 50,000; but ten times this number are urgently needed to give one per thousand of the population. Of the 2,300 hsien cities in China, however, already more than 1,800 have their own State clinic or hospital. Besides the mobilisation of old-style practitioners as auxiliaries, already mentioned, there has been a cutting down of the total time needed to qualify. The full qualification will still take five years; but medical assistants are being turned out after a two-year course, and technicians of various kinds need even less. The compression of the curriculum has been done by omission of matters which are unlikely to be met with by Chinese medical man, for example, the tropical diseases of South America. All teaching is now done in the Chinese language.

Both for research and teaching, Chinese scientific workers now have facilities incomparably greater than those which used to be available during the confusion and blockade of the Second World War. A great many instruments are now being made in the big cities such as Shanghai. In Academia Sinica laboratories, I saw excellent incubators and refrigerators, a variable-temperature insect-behaviour chamber, vacuum pumps, mechanical stirrers, shaking machines, ball mills and glassware, all made in China. A kind of 'Pyrex' ware is also locally available. Microtomes have been constructed by the Chinese Union Medical College workshops. At the Shenyang Medical School a consignment of two hundred teaching microscopes from East Germany had just come in during one of my visits, and my friends in the National Academy were making much use of East German catalogues. If normal conditions of trade can be restored, as all must hope, China would doubtless be glad to receive British scientific instruments. Heavier kinds of equipment are often Soviet in origin, and the Chinese are making excellent use of them.

Another emphasis which must be mentioned is that on popular education. There is a touching and genuine thirst for scientific knowledge among the Chinese people. Shops which sell anatomical models and geological charts have a crowd around the windows all day. If the visitors from the West wanders into one of the modern bookshops on Sunday, he will almost have to step over rows of children and boys and girls of various ages sitting on the floor and against the book cases reading popular science, and not paying the slightest attention to him. The assistants never insist on readers buying books, though they usually do, as they are relatively extremely cheap. I visited a popular exhibition of astronomy in the beautiful Pei Hai Park in Peking. It was packed with ordinary people, to say nothing of the usual large proportion of school-children, who were delighted with simple form of planetarium. Most justifiably there were special panels

accurately relating the ancient and medieval contributions of the Chinese to astronomy, such as the invention of the equatorial mounting by Kuo Shou-Ching in A. D. 1279; and the young man who was demonstrating these was delighted that a Western visitor was already familiar with these contributions and could even elaborate on them. Of great interest also was an exhibition of army education set up in the buildings surrounding the exquisite Temple of Heaven; here there were many pieces of simply constructed apparatus for demonstrating fundamental principles of physics, optics and the like; or, to take another example, out-patients passing through the corridors at China Union Medical College would pause to look at illuminated model scenes inset into the walls, which explain the cycles of transmission of the chief helminthic infections known in the Chinese countryside. Will it not make some difference to the world that five hundred million people are awakening to the significance of natural science and all that that implies?

Next, something may be said of a few of the researches which have been proceeding during the past three years. Stimulated by the importance of ethyl mercury chloride as a fungicide, the Institute of Physical Chemistry of the Academy has been studying the role of catalysts in the formation of this and similar compounds. The Institute of Organic Chemistry has been working on plant hormones and possible new antibiotics derived from certain plants traditionally used in Chinese medicine. From the point of view of economy it would obviously be of advantage to use as many of these as possible, and they are now undergoing more extensive study by modern methods than ever before; the China University Medical College, for example, has a special department for the investigation of Chinese materia medica. In physiology there has been work on microanalysis of potassium, sodium and phosphorus in nerve tissue during activity. The Laboratory of Developmental Physiology has completed researches on the structure and mode of action of the eye-stalk hormone of Crustacea, and has isolated an active substance in the form of its cadmium complex. Systematic botany and zoology are being actively pursued by many workers; often in connextion with important practical problems, such as forestry, fisheries, and the epidemiology of rodent-borne plague. Important work has been done by the Metallurigical Institute on new kinds of nodular graphite cast iron with superior strength and properties favourable to mechanical treatment. Its Kunming branch laboratory has been occupied with problems relating to the bauxite deposits of Yunnan province, and similar local needs. In so short a review as this it is, of course, impossible to do more than allude to a few of the subjects on which research is proceeding.

In conclusion, a few words may be said regarding the philosophical point of view of Chinese science to-day. In accordance with the world-outlook which has triumphed in China, Chinese scientists are greatly interested in dialectical materialism. The fact that there is very little opposition to it is noteworthy, and arises from several causes. There was never any strong strain of metaphysical idealism, such as that represented by Eddingtonian views, in Chinese thought. On the contrary, its finest formulation by the school of Chu Hsi in the Sung dynasty (twelfth century A. D.) was remarkably congruent with dialectical materialism, for this school worked with but two concepts: *ch'i*, matter, including its most tenuous forms, and *li*, the pattern or organization of things. These patterns were explicitly recognized to be arranged in levels of organization. For this world picture dialectical materialism may readily be considered a continuation. In other words, the age-old and refined conceptions of Chinese humanism are fusing with dialectical materialism without that stress and strain felt in a Europe which has so long been the battlefield of irreconcilable opposites—either theological spiritualism, or atoms and the void.

Weather Review — For the month of July, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January	Division	Station	Total for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	10·5	+ 6 9	14·1	South	Madurai	1·4	— 0·6	13·5
	Tirurkuppam*	9·6	+ 5·2	13·7		Pamban	0·3	— 0·2	12·0
	Vellore	8·9	+ 4·3	16·0		Koilpatti*	1·0	+ 0·4	19·2
	Gudiyatham*	15·5	+12·1	21·6		Palayamcottai	Nil	— 0·3	10·5
						Ambasamudram*	—	—	—
East Coast	Palur*	8·8	+ 5·3	16·4	West Coast	Trivandrum	5·7	— 2·1	35·7
	Tindivanam*	11·1	+ 7·4	19·8		Fort Cochin	18·7	— 4·6	83·4
	Cuddalore	4·0	+ 1·4	19·0		Kozhikode	30·2	— 4·1	105·0
	Nagapattinam	4·7	+ 3·0	11·9		Pattambi*	24·2	— 0·9	64·4
	Aduturai*	1·6	— 0 5	11·7		Taliparamba*	49·1	+ 4 0	108·8
	Pattukottai*	2 8	— 1·1	19·3		Wynaad*	21·1	— 1·5	50·8
						Nileshwar*	51·7	+ 5·8	126·4
						Pilicode*	46·9	+ 3 6	113·8
Central	Salem	5·4	+ 1·6	17·1		Mangalore	46·2	+ 6·8	102·8
	Coimbatore (A. M. O.)*	1·8	— 0·3	13·7		Kankanady*	47·2	+ 3·5	102·1
	Coimbatore	1·5	— 0·2	16·7	Hills	Kodaikanal	6·2	+ 1·5	35·2
	Tiruchirapalli	1·6	+ 0·5	12·9		Coonoor*	1·1	— 2·4	30·2
						Ootacamund*	6·1	— 1·2	21·4
						Nanjanad*	15·1	+ 3·8	31·6

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

On the first day of the month the monsoon was weak along the West Coast. On the next day it became vigorous, particularly north of Cochin. Widespread rains were received till 8-7-1954 along the West Coast with a few localised light to moderate showers in different parts of Tamilnad. On 9-7-1954 the monsoon became slightly weak along the West Coast and remained so for four days. On 13-7-1954 it became definitely weak in Malabar and South Kanara. Again it gained strength on 15-7-1954 and retained it for a week. During this period light to moderate rains were received in different parts of Tamilnad. A Temporary break in the monsoon was noted throughout the country on 22-7-1954 and it persisted for three days. On 25-7-1954 the monsoon revived and continued to be so till the end of month with mild changes in vigor even along the West Coast. Localised light rains were received in different parts of Tamilnad in the last week of the month. The note-worthy rainfalls and the zonal rainfall for the month are furnished hereunder :—

Note-worthy Rainfalls for the Month

Date	Name of Place	Rainfall	Name of Zone	Av. rainfall for July	Dep. from normal	Remarks
1/7/54	Kallakurichi	3·0″	North	11·1	+ 7·1	Far above normal
5, 18 & 23/7/54	Mangalore	4·0″	East Coast	5·5	+ 2·6	,,
6/7/54	Mercara	10·0″	Central	2·6	+ 0·4	Above normal
,,	Palghat	4·1″	South	—	—	—
17/7/54	Calicut	4 0″	West Coast	34·1	+ 1·1	Above normal
24/7/54	Madras (Nungambakkam)	3·0″	Hills	7·1	+ 0·4	Just above normal

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 12—8—1954

C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATION

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Ramaswami Mudaliar, V.	On leave	Asst. Cotton Specialist, Srivilliputhoor
Rajaratnam Chetty, S.	On deputation to Mysore Govt.	Spl. D. A. O. Crop Sampling, Salem
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The Madras Agricultural Journal

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The Madras Agricultural Journal

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Editorial

Atom and Agriculture: With Einstein propounding $E = mc^2$ the atomic age came into being and Hiroshima had the first impact. This installed the era of terror and competitive research in weapons of destruction. But very soon people realised that mere creation of new and terrifying weapons of war to make mankind cower and shake in fear is not the be all and end all of the "Atom". The fact that the "Atom" can become one of man's servants is now admitted on all sides. "To hasten the day when the fear of the "Atom" will begin to disappear from the minds of people and the Governments of the East and the West" has now become the keynote of the policy of responsible Governments. The United States of America has consequently developed an Atom Pool Plan recently. This plan proposes to accelerate the peaceful uses of the "Atom," foster dissemination of atomic information and encourage the acquisition of new fundamental data and theory. India too, is not lagging behind as is evident from the recent pronouncements of our Prime Minister Pandit Nehru this month in the Lok Sabha that he proposes to call for a conference in Delhi some time in November this year, to study the possibility of using atomic energy for peaceful purposes.

It is agreed all around that there will be no lasting peace even with the atom and hydrogen bombs, until such time as conditions are so improved as to provide all the people of the world with a diet that is adequate for health and well being. As pointed out by Dr. Kesteven of F. A. O. with 68,000 extra people to be fed every morning we have to seriously think of utilising the "friendly atom". Governments of all countries being alive to this, the time is not far distant when the "Atom" will be utilised for Industry and Agriculture. But how is this "Atom" going to be harnessed for peaceful needs ? The initial attempts in the utilisation of atomic energy has been directed towards the production of abundant electrical energy. This requires that the fission reaction be made to proceed slowly under control and

not to liberate the energy, in a millionth of a second as in the atom bomb. This is certainly possible. By this the atomic fuel would provide three million times as much energy as the same weight of coal. If therefore, this transformation of atomic energy to electrical power could be done in power starved areas of the world, it would revolutionise farm power in agriculture.

In the United States, the Atomic energy Commission is supporting several schemes which have revolutionary potentialities of producing bumper crops unheard of before. The new process of obtaining both phosphatic fertiliser and Uranium from the Florida phosphate area is another achievement of the Atomic Energy Commission. Since World War II, the man hour requirements for growing 100 bushels of wheat have been reduced from 41 to 31 in U. S. A. For the first time in the annals of our country radio active isotopic material made available through the Indo-US Technical Aid Programme is being utilised at the Indian Agricultural Research Institute, New Delhi for studies in crop nutrition. Provision is also made for a central tracer laboratory for study, through tracer technique, the exact path of the metabolism of the different nutrients. Radio active phosphorus, as applied through phosphatic fertilisers, is first taken up for study. The other plant nutrients, nitrogen and potassium, would be studied subsequently. This new technique is bound to divulge hitherto unknown agricultural information.

At the Atomic Energy Commissions' Long-Island Laboratories near New York, many plant mutants with promising yield characteristics, have been developed with radio active cobalt. Through atomic radiation disease resistant strains of crops are reported to have been evolved. Tuber crops like potatoes are preserved for over two years through the use of atomic radiation. Pesticides and fungicides also come under the scope of development through the use of radio active isotopes, which track down the exact path of the chemicals in destroying the pests. Therefore, much scope of advancement in Agriculture is possible through the use of the "Atom" in the near future.

Recent Developments in the Chemotherapy of Plant Diseases *

by

G. RANGASWAMI

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Introduction: The search for chemical substances to control plant and animal diseases started as soon as the microbial nature of the diseases was established early in the nineteenth century. At present several chemical substances, both inorganic and organic, are being used for combating these diseases. But the study of plant chemotherapy i. e. the treatment of plant diseases with chemicals which act within the host plant is a relatively recent subject and more and more attention is being paid to it at present in the United States of America and in England. An attempt is made here to bring together the latest developments and findings in plant chemotherapy.

Mode of action and the method of application of chemotherapeutants: It is generally understood that the symptoms of plant diseases are brought about either by the direct action of the pathogen on the host or from the host's reaction to the toxins produced by the pathogen. As a general rule the food supply available inside the plant tissue does not meet the specific requirements of the pathogen and so the establishment of the organism inside the host is prevented unless the host is susceptible to the specific organism. But in some cases the presence of fungistatic and fungicidal chemicals within the host tissue offers a natural resistance for the plant. The presence of protocatechuic acid in the scales of onions is a ready example. The object of chemotherapy is to introduce into the plant system some chemicals which can bring about the resistance or in other words immunize the plants against certain phytopathogens. These chemicals are known to act at least in two different ways: (1) by direct action on the pathogen and (2) by antidoting the toxins produced by the pathogen. Again, there are more than one way by which these effects are brought about by these chemicals. Some of them like hydrogen sulphide and hydrogen cyanide gases when applied externally are known to penetrate deep inside the host tissue and check the spread of the pathogen after it had entered the host. In this case the chemical is known to be a topical chemotherapeutant. When the chemical, applied to one part of the plant, diffuses to the other parts and arrest the pathogen or antidotes the toxins produced by it, it is known as a a systemic chemotherapeutant. In a few cases the chemical may change the degree of resistance of the host to the pathogen by bringing about a change in the metabolic activity of the plant.

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* Paper presented for the 1954 College Day and Conference Symposium on "Recent Advances in Agriculture".

There are several ways by which the chemotherapeutants are introduced into the plant system of which injection and translocation, soil treatment and root absorption and foliage application and leaf absorption are the important ones. Injection of the chemical into the stem was one of the common methods used by earlier workers, but in recent years the other two methods are reported to be more useful. In the case of Dutch elm disease it was found that when 8-quinolinol benzoate was applied to the roots, there was better control than when injected into the stem, the chemical injected into the stem was translocated readily in the longitudinal direction, but the radial and tangential transmission was very poor (Dimond *et al* 1949). Similar results have been reported for the bacterial blight of beans and X-disease of peach. There is enough evidence to show that the chemicals applied to the leaf surface are absorbed by the leaf and transmitted systematically, but the degree of absorption may vary with the chemical as well as the plant. Perhaps soil application of the chemical is the easiest and the best method but it has been found that many of the chemicals are less stable in the soil, thus warranting a serial application at periodical intervals. It is also known that certain chemicals and antibiotics lose their activity inside the plant which may be due to slow break down or dilution of the chemotherapeutant due to the effect of the growth of the plant. So the treatment in such cases may have to be repeated at closer intervals.

Most of the chemothrapeutants are known to be quite effective even in very small doses and it is more so with antibiotics which are effective at doses below I: 10,000. Some of them have been reported to be phytotoxic at higher levels, but the nonphytotoxic dosage, the time and frequency of treatment etc., are details to be worked out for a given set of conditions.

Organic Compounds as Chemotherapeutants: Several organic and inorganic compounds have been tested for their chemotherapeutic value in plants against fungal, bacterial and virus diseases but only a few of them were found to be effective. Some of the important diseases which have been successfully treated by the chemicals other than antibiotic substances are listed in Table I.

Antibiotics as Chemotherapeutants: Of the more than one hundred antibiotics so far reported to have been isolated from microorgaisms, only a small number has been tested in plants and among them only a few have been reported to be useful as chemotherapeutants. The action of antibiotics against plant viruses is at present a controversial topic as some workers believe that the virus principle is inactivated by the antibiotic as indicated in the *in vitro* experiments and others believe that they bring about a change in the host tissue resulting in the resistance of the plant to virus infection. The important fungal, bacterial and virus diseases of crop plants controlled by antibiotic chemotherapy are given in Table II.

TABLE I

Some of the important plant diseases controlled by chemotherapy

No.	Name of the disease	Casual agent	Chemotherapeutant	Authority	
I	**Fungus Diseases:**				
1.	Dutch elm disease	*Ceratostomella ulmi*	(i) 8-quinolinol benzoate (ii) 2-carboxymethyl mercaptobenzo-thiazole salts	Dimond *et al* Dimond and Davis	(1949) (1952)
2.	Wilt of tomato	*Fusarium lycopersici*	(i) 8-quinolinol sulphate (ii) Na and K 2-benzothiazolyl-thio-glycolates	Stoddard and Dimond Dimond and Davis	(1951) (1953)
3.	Wilt of carnations	*Fusarium* sp.	4-chloro-3, 5-dimethylphenoxye-thanol; 2-norcamphane metha-nol; 8-quinolinol sulphate	Stoddard and Dimond	(1951)
4.	Wilt of greenhouse stock (*Matthiola incana*)	*Rhizoctonia* sp.	8-quinolinol sulphate	Stoddard and Dimond	(1951)
5.	Root rot of Vanda orchids	*Fusarium* sp.	T. M. T. D.	Murakishi	(1953)
6.	Wilt of egg plants	*Verticillium* sp.	2-carboxymethylmercapto-benzo-thiazole salts	Dimond and Davis	(1953)
7.	Oak wilt	*Chalara quercina*	Disodium ethylene bisodium car-bamate + 2-mercaptobenzothia-zole; 8-hydroxyquinoline etc.	Hoffman	(1952)
8.	Early blight of tomato	*Alternaria solani*	(i) 4-nitrosopyrazoles (ii) 2-carboxymethylmercapto-benzo-thiazole salts (iii) 1-p-sulfamylphenyl-3, 5-dime-thyl-4-nitrosopyrazole; 2, 4, 6-trichlorophenoxy acetic acid	McNew and Sundholm Dimond and Davis Stubbs	(1949) (1952) (1952)

No.	Name of the diseaso	Casual agent	Chemotherapeutant	Authority	
9.	Chocolate leaf spot of beans	*Botrytis cinerea* and *B. fabae*	(i) Aryloxyaliphatic acids	Crowdy and Wian	(1951)
			(ii) 2, 4, 6-trichlorophenoxyacetic acid	Crowdy and Elizabeth	(1952)
			(iii) Mono-, di-, and trichloro-beta-naphthols	Byrde *et al*	(1953)
10.	Stem rust of wheat	*Puccinia graminis tritici*	(i) Calcium sulfamate	Livingston	(1953)
			(ii) Sulphdiazine; 3-sulphanilamile-6-methyl pyridazine	Hotson	(1953)
II	**Bacterial Diseases:**				
1.	Bacterial blight of beans	*Xanthomonas phaseoli*	Salicylic acid; Auamine	Dimond and Stoddard	(1948)
.2.	Crown gall of fruit trees	*Bacterium tumefaciens*	Sodium dinitro-o-cresylate	Ark	(1941)
III	**Virus Diseases:**				
1.	X-disease of peach	virus	Quinhydron; hydroquinone; 8-quinolinol sulphate; p-nitrophenol; p-amino-benzene sulphamide	Stoddard	(1947)
2.	Leaf roll of potato	virus	2, 4-dichlorophenoxyacetic acid	Lock	(1948)
			2-methyl-4-chlorophenoxy	Limasset *et al*	(1948)
3.	Potato virus X and Y	virus	acetic acid		
4.	Tobacco mosaic	virus	(i) 4-chloro-3, 5-dimethylphenoxy ethanol	Davis	(1952)
			(ii) Thiouracil	Nichols	(1954)

TABLE II
Plant diseases controlled by antibiotic chemotherapy

No.	Name of the disease	Causal agent	Chemotherapeutant	Authority	
I	**Fungus Diseases:**				
1.	Early blight of tomato	*Alternaria solani*	Griseofulvin	Brian	(1952)
2.	Late blight of potato	*Phytophthora infestans*	Terramycin	Bonde	(1953)
3.	Seedling blight of oats and barley	*Helminthosporium victoriae*	Helixin B	Leben *et al*	(1953)
4.	Wilt of tomato	*Fusarium oxysporum* var. *lycopersici*	Thiolutin	Gopalakrishnan & Jump	(1952)
5.	Stem rust of wheat	*Puccinia graminis tritici*	Actidione	Livingston	(1953)
6.	Mildew of oats and barley	*Erysiphe graminis*	Griseofulvin	Brian	(1952)
II	**Bacterial Diseases:**				
1.	Crown gall of fruit trees	*Bacterium tumefaciens*	Penitalin	Repert & Hawas	(1951)
2.	Gall on tomato	*Agrobacterium tumefaciens*	Aureomycin	Blanchard	(1951)
3.	Bacterial blight of beans	*Xanthomonas phaseoli*	Streptomycin	Mitchell *et al*	(1952)
4.	Leaf drop of fruit trees	*Xanthomonas pruni*	Streptomycin; Terramycin	Dunegan *et al*	(1953)
III	**Virus Diseases:**				
1.	Tobacco necrosis	virus	(i) Terramycin (ii) Trichothecin	Leben & Fulton	(1952)
2.	Tobacco mosaic	virus	Trichothecin	Bawden & Freeman	(1952)
3.	Tomato bushy stunt	virus	Trichothecin	Bawden & Freeman	(1952)

Discussion: Though the chemotherapy of plant diseases is known to be one of the most important methods of plant disease control particularly so for systemic diseases, comparatively little attention has been paid to it so far. Perhaps this is due to want of sufficient knowledge on the chemotherapeutic agents and also phytotoxic nature of those known to be antimicrobial. Further the translocation of the chemicals introduced into the plant is brought about mostly by osmosis and is very slow as compared to the translocation in the blood stream in animal which is more conducive and effective in combating pathogens. With the increasing knowledge on the chemotherapeutic value of some of the organic substances and the etiology of the disease more and more attention is being paid to overcome the obstacles observed in previous years. Moreover it has been recently observed that some of the chemicals which did not show much antimicrobial property *in vitro* proved to be quite useful as chemotherapeutic agents. Davis and Dimond (1953) found that the plant growth regulators, 2,4-D, α-naphthalene acetic acid and indol-3-acetic acid, which had relatively low fungitoxicity *in vitro* when applied to the tomato plants four to ten days prior to inoculating with *Fusarium oxysporum*, the wilt disease was reduced or prevented. A change in the host metabolism showing reduced sugar content of tissues was recorded. The longer the interval between treatment and inoculation the more potent was the chemotherapuetic effect. Gupta and Price (1952) obtained similar results when the culture filtrate of *Trichothecium roseum* was tested against Southern bean mosaic. These findings have opened a new line of approach in chemotherapy of plant diseases, wherein it is required to test all chemicals for activity irrespective of their antimicrobial property *in vitro*. In this connection one important precaution to be observed is to see that the quality of the produce is not adversely affected by the chemotherapeutants. It is hoped that a vigorous approach from the biological as well as chemical aspects of these complicated problems is bound to yield better results.

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The Intake of Silica by the Rice Plant with Reference to Blast Disease *

by

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Introduction: The blast disease caused by the fungus Piricularia Oryzae is the most serious disease of the rice crop, but is prevalent only on certain strains of paddy while others are immune to it. Hence the effective control of the disease at present is only through the use of resistant strains. Among the Madras strains, Co_4 (Coimbatore 4) is highly resistant even under worst conditions while the variety Adt_{10} (Aduthurai 10) is highly susceptiable to the disease. The latter strain is however a high yielder and hence very popular in the Tanjore Delta.

In modern times with the advancement of science many of the characters such as resistance and other factors which are indissoluble Mendelian factors of inheritance, located in the genes of chromosomes have been explained through enzymology in terms of certain set chemical reactions resulting in definite chemical compounds. Hence this inheritance of resistance to blast, located in specific strains were aimed to be studied in terms of possible chemical constituents in the strains which bestowed on the strains the disease resistance.

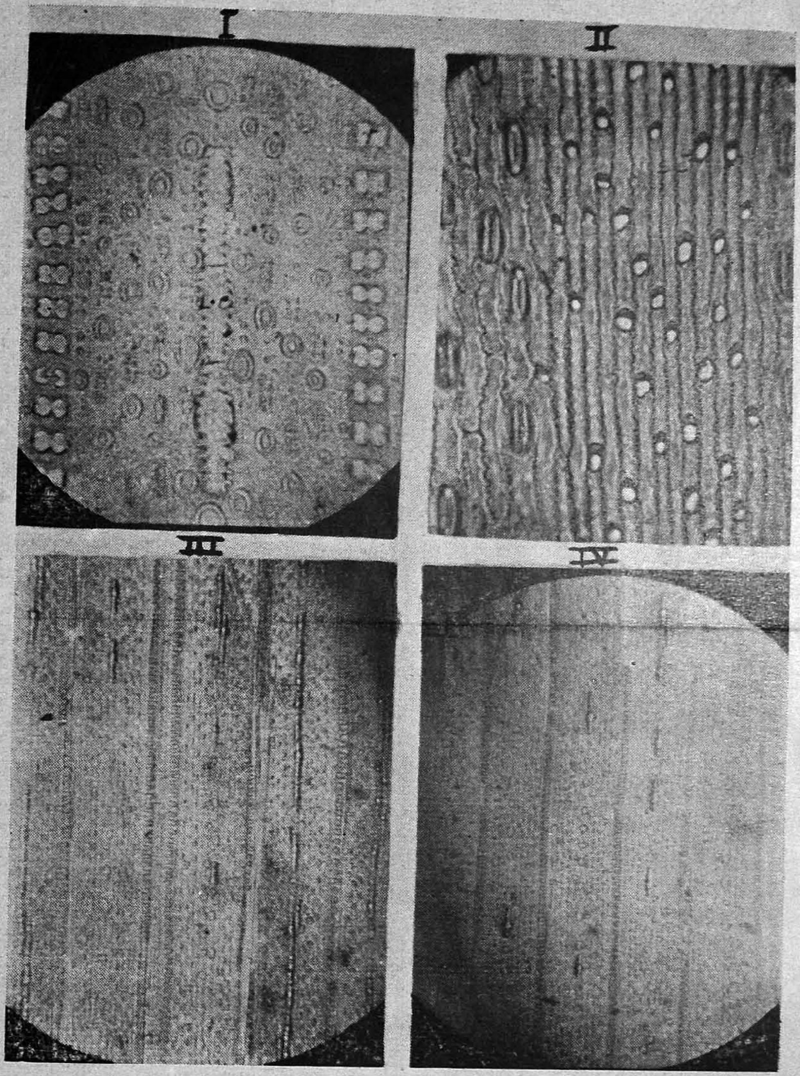
A perusal of literature on the subject of disease resistance in general and with special reference to paddy blast revealed a considerable volume of experimental evidence in favour of a plausible relationship of silica in the plant to disease resistance. Thus Onodera (1), Miyake and Adachi (2), Kawashima (3), Ikari and Kubota (4), Miyake and Ikeda (5), Ito and Hyashi (6) have all correlated silica in the rice plant to blast resistance. Suzuki (7) examining through a microscope the cross sections of the leaves and pedicels of spikes of the rice plants recognised that the outermost layers of the epidermal cell walls contained great amounts of silica and that these silicated cells were greater in the resistant variety than in the susceptible one.

A preliminary study conducted on the anatomical and chemical aspects taking pre-harvest samples of plant material belonging to the varieties Co_4 and Adt_{10} growing under identical conditions revealed the following features:—

1. *Anatomical Studies:* A number of epidermal peelings of leaves and stems at the neck of earhead of the two varieties obtained by macerating the tissue with concentrated nitric acid and potassium chlorate (as bleaching agent) were examined under the microscope and were found

* Awarded Venkataswamy Naidu's Silver medal on the College Day 1954.

To face page 304:



Microphotograph of:

PLATE I: Leaf epidermis of rice plant under high power of microscope showing the silicated long cells (l. c.) and silicated short cells (r).

PLATE II: Stem epidermis under high power showing silicated short cells (s. c.).

PLATE III & IV: Leaf epidermis under low power of Co_4 and Adt_{10} respectively showing comparatively higher silication in the variety Co_4 than Adt_{10} with reference to the silicated long cells.

to exhibit extensive silication in the form of short and long cells. These silicated epidermal cells were easily detected under the microscope when stained with phenol or chloriodide of zinc and were found to be greater per unit area of Carl Ziess 7×40 in the resistant variety Co_4 than in the susceptible one Adt_{10}. Plates I to IV show the nature of silicated cells in the leaf and stem epidermis.

2. *Chemical Studies:* Chemical analysis of leaves and stems for silica content showed that the susceptible variety contained more silica than the resistant one.

Thus while the findings of the anatomical studies made on the leaves and stems were in line with those of the Japanese workers, the chemical analysis gave results of a contradictory nature. Hence it was decided to study in detail the intake and distribution of silica in the two varieties of rice plant.

Material and Method: The rice plants were raised in pots and the two series of pots viz., Co_4 and Adt_{10} were maintained under identical conditions of irrigation etc.,

Chemical Analysis: Samples of plant material viz., leaves, stems roots, panicles and whole plants, were collected at different stages of growth and were analysed for dry matter, ash and silica. Estimation of silica was done using hydrofluoric acid on the sulphated ash.

Discussion of results: The results of analysis of the plants and plant parts of the varieties Co_4 and Adt_{10} sampled at different stages of growth given in table I present the following features :-

1. *General:* There is a continuous absorption of silica during the life of the plant upto the grain formation stage after which the absorption ceases. The leaves and stems attain their maximum silica content by the time the flowering has taken place and the grains begin to set. The panicles show an increase in silica content even after grain formation stage and there is a coincidental fall in the silica content of leaves and stems. Thus there is a certain amount of evidence of movement of silica from one part of the plant to another. The results of analysis of roots are irregular especially in the case of Adt_{10} at flowering and this is reflected in the whole plant analysis.

2. *Silica content of leaves, stems etc, with reference to resistance to blast:* When the silica content of leaves and stems is expressed as percent of ash, dry matter or green matter, the resistant variety does not show higher value than the susceptible variety, especially after the plants have come to maturity as was also observed in the preliminary studies. The results of analysis of whole plant sample show that the plants sampled at tillering stage show greater silica content in the resistant

variety than the susceptible variety. Thus while there is an indication of the resistant variety having more silica than the susceptible variety when the plant as a whole is considered during the vegetative phase, the analysis of leaves and stems after the plants have come to maturity, do not show greater silica content in the resistant variety than in the susceptible one.

TABLE I. Showing the silica content in leaves, stems etc. of the varieties Co_4 and Adt_{10} at different stages of growth
(Percentages)

Material analysed and stage of growth	SILICA CONTENT					
	Ash basis		Dry Matter basis		Green Matter basis	
	Co_4	Adt_{10}	Co_4	Adt_{10}	Co_4	Adt_{10}
1. *Leaves:*						
(a) Mature Plant Stage	55·02	54·46	10·86	10·70	3·14	2·77
(b) Flowering Stage	63·58	68·22	12·75	16·48	3·73	4·41
(c) Grain formation ,,	63 76	71 34	12·16	18·52	4·30	5·81
(d) Harvest ,,	57 11	60·16	11·24	12·12	4·11	4·32
2. *Stem:*						
(a) Mature Plant Stage	30 78	37·87	5·71	8 18	0·97	1·26
(b) Flowering ,,	48·09	50·22	8·99	12·45	1·55	2·05
(c) Grain formation ,,	48·84	50·19	8·32	13·33	2·02	2·93
(d) Harvest ,,	47·88	50·06	7·97	10·14	1·98	2·22
3. *Panicles:*						
(a) Flowering Stage ,,	53·09	65·72	4·19	8·19	1·13	2·14
(b) Grain Formation Stage	76·37	77 47	9·47	8·33	5·74	5·04
(c) Harvest ,,	82·81	79·73	17·17	11·32	12·28	9·06
4. *Roots:*						
(a) Mature Plant Stage	10 69	5·55	1·50	0·76	0·30	0·15
(b) Flowering ,,	29·20	30·40	3·95	4·37	0·66	0·83
(c) Grain Formation Stage	40·87	23 72	5·46	4·47	0·90	0·78
(d) Harvest Stage	35·75	38·68	5·23	5·79	0·82	0·91
5. *Whole Plants:*						
(a) Beginning to tiller	31·23	24·29	5·07	4 27	0·79	0·58
(b) Mature Plant Stage	37·82	43·69	6·20	8·99	1·23	1·54
(c) Flowering Stage	52·78	48·52	9·45	8 99	1·69	1·66
(d) Grain Formation Stage	53·83	59·54	9·84	13·07	2·80	2·95

TABLE II. Showing intake of silica during different periods of growth as percent of total intake
(Calculation based on silica on ash figures in table I)

	Leaves		Stems		Panicles	
	Co_4	Adt_{10}	Co_4	Adt_{10}	Co_4	Adt_{10}
1. Upto Maturity ..	*86·3*	*76·3*	63·0	75·4	—	—
2. Maturity to flowering ..	13·4	19·9	*35·4*	*24·6*	*64·1	82·4*
3. Flowering to grain formation ..	0·3	4·4	1·6	Nil	*28·1*	*14·7*
4. Grain formation to harvest ..	Nil	Nil	Nil	Nil	7·8	2·9

* Represents silica content at flowering as percent of total intake.

3. *Intake of silica during critical periods of vulnerability of the plant parts to fungus attack expressed as percent of total intake:* The critical periods of vulnerability to attack differ with the different parts of the plant. Thus during the early stages of growth of the plant the foliage is more exposed to fungus attack than the stems, the latter being covered by leaf sheaths. The time when the stem is really and badly exposed to attack is when it emerges through the flag leaf bearing the earhead i. e., at the time of flowering. At that time the stems are not only well exposed but are also very juicy conducting nutrients to panicle. Thus under actual field conditions we find that the stems mainly suffer the fungal attack at the neck of the earhead (portion below earhead) at flowering stage while the foliage are attacked much earlier, even from the nursery stage. Hence it would be but right to find out if there is any correlation of silica intake at these critical periods with the resistance of the plant to disease. Table II gives data pertaining to this. It is found from the data therein that a definite correlation does exist between the rate of intake during the critical periods of vulnerability to attack and the resistance. Thus we find during the vegetative stage when the leaves are more exposed to attack the intake of silica in leaves is greater in the resistant variety than in the susceptible one (86% of total in Co_4; 76% in Adt_{10}). The variety Co_4 is a longer duration one (180 days) than Adt_{10} (165 days) and the more rapid intake of silica is not a function of an enhanced rate of maturation processes. Again from maturity to flowering when as mentioned before the stem is more exposed to attack, the intake by this part of the plant is greater in the resistant variety than in the susceptible one (35% in Co_4; 25% in Adt_{10}). It is similarly high in the panicles of the resistant variety from the flowering stage to harvest. The panicles of the resistant variety show greater intake than the susceptible one (35 9% in Co_4; and 17·6% in Adt_{10}). Thus, while the silica in the plant when considered as mere total contents at a particular date does not give a correct indication of the role of silica in the resistance of the plant to disease, the representation of the intake during the critical periods of vulnerability to fungal attack expressed as percentage of total intake gives the correct picture.

TABLE III. Showing the dry matter percentage, in leaves, stems etc. at different stages of growth

Stages of growth	Leaf		Stem		Panicle		Root	
	Co_4	Adt_{10}	Co_4	Adt_{10}	Co_4	Adt_{10}	Co_4	Adt_{10}
1. Mature plants	28 98	25·84	16·92	15·38	—	—	20·20	19·80
2. Flowering	29·27	26·74	17·16	16·46	27 08	26·13	19·69	18·94
3. Grain formation	35·40	31·39	24·30	22·00	60 02	60 57	16 38	17·36
4. Harvest	36·58	35·73	24·84	21·84	71·56	79·99	15·63	15·63

4. *Presentation of silica on surface area basis in leaves:* Another interesting feature is presented by the data of dry matter contents of the parts analysed as given in table III. It is seen from the data in this table that at all stages of growth, the leaves, stems etc., show a greater dry matter percent in the resistant variety Co_4 than in the susceptible one Adt_{10}, exceptions being very few, noticed in roots and panicles only. The greater amount of dry matter in leaves, stems etc., of the variety Co_4, it was speculated would mask the results of analysis for silica when represented on the basis of weight. If this be acceded, the presentation of silica on the basis of the area of the surface on which it is distributed would give a better picture of silication, as silica is mostly confined to the epidermal regions. To confirm this, a study was made on the leaves of the two varieties collected at harvest stage.

Two sets of 50 leaves were collected for each of the two varieties from the bulk sample used for chemical studies. Every 10th or 15th leaf from the bulk was taken according to the size of bulk. The surface area was measured by using a planimeter on the outlines of leaves traced on tissue paper. Silica was estimated as usual after drying the material and the results expressed on area basis. The results are given in table IV.

TABLE IV. Showing silica in leaves represented on area basis

No.	Particulars	Experiment I		Experiment II	
		Co_4	Adt_{10}	Co_4	Adt_{10}
1.	Green weight of 50 leaves in grams	23·1390	18 1630	22·9550	17·6340
2.	Dry weight ,, ,,	8·4650	6.4950	8·4404	6·1240
3.	Ash weight ,, ,,	1·5810	1·3780	1·5770	1·2990
4.	Silica in 50 leaves in milligrams	952 0	784 0	949 0	742 0
5.	Total surface area in sq. cm.	2742	2472	2534·4	2420
6.	Silica per 100 sq. cm. of leaf surface in milli grams	34 85	31·85	36·60	30·70
7.	Silica as percent of dry matter	11·25	12·12	11·25	12·12

It is seen from the data given in table IV that the differences in green weight, dry weight and ash weight is considerable in the two varieties, Co_4 showing higher value than Adt_{10}. It is also seen that the silica content per unit area is greater in Co_4 than in Adt_{10}.

Conclusion: 1. Chemical analysis of leaves and stems sampled at different stages of growth show that the silica content when represented on the basis of dry weight, green weight or ash weight bears no correlation to the resistance of the plant to blast i. e., the resistant variety Co_4 does not show higher silica content than the susceptible one Adt_{10}. However, when the silica intake in leaves, stems and panicles during the critical period of vulnerability to fungal attack is expressed as percent of total intake, there is a direct correlation between silica and resistance, the resistant variety Co_4 showing greater intake than the susceptible variety Adt_{10}.

2. The computation of silica on the basis of surface area, based on chemical analysis, gives a better picture of the silica distribution in the different parts of plant than when represented on the basis of weight and this is in line with the observation made in the anatomical studies in which the resistant variety showed more silicated cells.

3. Hence it is evident that consideration of total silica does not give the correct picture of the role of silica in the resistance of the rice plant to blast disease. But from this study it was established that the rate of absorption of silica by the plant parts during the critical period of vulnerability to fungal attack is the factor which decides resistance or susceptibility of a rice variety.

Summary: The blast disease on paddy caused by the fungus Piricularia Oryzae though the most serious disease of the rice crop is not prevalent on all strains of paddy. Paddy strains like Co_4 are completely immune to it. It was sought to find out criteria of a chemical nature that would indicate resistance or susceptibility. A perusal of literature on the subject showed all evidence in favour of silica as the factor responsible for resistance. However, preliminary chemical analysis of plants of the resistant variety Co_4 and a susceptible one Adt_{10} showed no greater silica content in Co_4 than in Adt_{10}, though the anatomical studies on the epidermal peelings of leaves and stems showed greater number of silicated cells in Co_4 than in Adt_{10}. Hence, a detailed study on the intake of silica by the two varieties was taken up. Plants were raised in pots. Chemical analysis for silica content was done on leaves, stems, etc. at different stages of growth and the results expressed as (i) total intake at different stages on the basis of dry matter weight etc., (ii) intake during critical periods of vulnerability to fungal attack as percent of total intake and (iii) silica content on the basis of surface area of leaves. The following conclusions were drawn:

1. The total intake of silica by leaves and stems is not correlated with the resistance to disease.

2. The intake of silica during the critical period of vulnerability of the plant to fungal attack is directly correlated with the resistance to disease, the resistant variety showing more of intake than the susceptible one.

3. Silica as assessed on the basis of area instead of on dry matter basis gives a better picture of the distribution of silica in the leaves and confirms the findings made by the anatomical studies in which greater number of silicated cells per unit area was observed in the resistant variety than in the susceptible one.

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Recent Advances in Agriculture with Special Reference to Weed Control

by

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Introduction: Taking "recent" to mean within the past ten years, a number of new developments can be enumerated as constituting advances in the field of agriculture. But from the view-point of plant physiology, these developments can be narrowed down to just three or four, viz., in the field of plant nutrition with special reference to micro-nutrients, photoperiodism, hydroponics, dormancy and growth-hormones. The last one is perhaps the most outstanding, but within the scope of this paper it is proposed to discuss only a single aspect of growth hormones, namely their potentialities as weedicides.

*Paper read at the 1954 College Day and Conference Symposium on "Recent Advances in Agriculture."

Growth Hormones: The discovery of the hormone system in plants and the later isolation and synthetic production of numerous substances which regulate growth in plants, has been one of the outstanding achievements in Plant Physiology. The term "Hormones" has been used for these substances (From the Greek *Hormacin*: to set moving) as they were believed to be produced in one portion of the plant body and manifest their effects in other portions, but it is preferable to use the term "growth-regulators" or "growth-regulating substances" when the group of synthetic chemicals is referred to. These compounds have an astonishingly diverse range of effects upon plants and new uses are being constantly added to, as more. is known about the nature of the responses that these compounds can produce. They are capable of regulating growth in some part or other of the plant body, and in contrast to the indirect effects of insecticides and fungicides that merely serve to protect the plants from injury, these compounds act directly upon the plant metabolism in a physiological sense, although in a manner that is distinct from fertilizer materials that supply major or minor nutrient elements.

A large-scale use of plant growth-substances has fostered within the last ten years, a million-dollar business in the United States of America, Great Britain and other countries of the West. Thus "2, 4-D," which was once used only in minute doses in the laboratory was produced in 1948 to a total of nearly thirty million pounds, mainly for for weed eradication.

The use of growth-regulating chemicals for encouraging better and quicker rooting of plant cuttings is now quite well-known and is used generally by gardeners in other lands. The main limitation to a still wider use of these chemicals (among which β-indole-butyric acid is the most popular) lies in the fact that most of the horticulturally valuable plants come under the group of "difficult to root" plants, where growth-regulators have only a moderate effect.

Weed Control by growth-regulating chemicals: In 1943—1944 chemicals of the "phenoxy" type were studied intensively as part of secret, war-time research in Great Britain, towards perfecting chemicals for destroying enemy crops. These chemicals act by over-stimulating the plants' physiological processes so much as to "burn themselves out", so to speak. The compounds "2, 4-D" and "MCPA" were the most effective; they were able to kill off all broad-leaved dicotyledonous weeds growing in cereal crops when used at dosages of 1 to 4 lb. per acre without affecting the cereal crops and thereby came to be known as selective weedicides. Weed killing is at present by far the most important practical use of these "hormone" chemicals.

There has been in recent years quite a phenomenal increase in the use of "2, 4-D" as a weedicide all over the world (except perhaps in

India). The second in importance is the use of alpha-naphthalene-acetic acid to prevent pre-harvest drop of apples. "2, 4-D" alone has a potential annual market of more than 500 tons and can soon be expected to top the list of all organic agricultural compounds.

Since "2, 4-D" and allied compounds are less effective against grass weeds, new weedicide chemicals are being tested and very recently one or two have been claimed to be quite effective.

Indian work: "2, 4-D" or its near analogue, "M.C.P.A." have been found extremely effective in destroying water hyacinth by a number of workers viz. Mitra. (1948), Thomas and Srinivasan (1949) Lal and Scott-Padwick (1948). Prasad (1952) found that Crag Herbicide was effective in killing *Orobanche* in tobacco without injury to tobacco plants. "2:4-D" and "MCPA" formulations like Agroxone, Fernoxone, and Dicotox were found very effective against *Convolvulus arvensis* (Bindweed) and *Chenopodium album* but they were ineffective at the strengths tried, against Spurrey. Against grass type weeds, Kalamkar and Ekbote (1953) found that "CMU" at 20 lb. per acre was effective against *Saccharum spontaneum*, but "TCA" was not effective.

At Coimbatore, work is proceeding since 1953 on weed control by chemical herbicides. A mixture of "2, 4-D" and "MCPA" in the form of the sodium salts at 5 lb. rate in 50 gallons per acre gave 90 to 100 % mortality in *Cyperus rotundus* (Nut grass) in the course of 3 to 4 weeks from spraying date and regrowth was prevented for a period of nearly three months. A combination spray of these two chemicals mixed with diesel oil gave a complete kill of *Cyperus* within two weeks. Against *Hariali* (*Cynodon dactylon*) too, well-established stands could be killed off in 4 to 5 days time by 2, 4-D" and pentachlorophenol (PCP) in diesel oil. "PCP" is unable to kill off the underground portions, but "2, 4-D" can destroy them to some extent. The plots so treated were free of *hariali* for over two months. For complete eradication a combination of herbicidal and cultural measures seems to be necessary.

A good deal of valuable information has been gathered already on the effect of numerous weedicide chemicals on a wide variety of weeds and the work is being continued.

A new method has been devised and used for the detection of toxicity left in the soil when the land is sprayed with herbicides, to see when it is safe to use that land again for cropping. The method is based upon the reduction of growth in cucumber seedlings by varying concentrations of growth-regulating substances. From these studies it was noted that residual toxicity was less persistent in "MCPA" than with "2, 4-D"

Work is also in progress at Coimbatore on the control of *Striga* by the use of the hormone type of weedicides.

It is hardly necessary to stress the fact that a great deal of work still remains to be done, in testing the latest herbicides against the major weeds in India and especially in Madras, in the case of troublesome and persistent weeds like Hariali, Kikuyu grass and Cyperus. Spurrey and Oxalis are two bad weeds on the Hills for which effective and inexpensive control measures are yet to be found. Woody weeds like Lantana and Gorse are also quite a problem in certain areas. These require a different type of herbicides and much work is needed before effective control measures can be suggested.

A vast unexplored field of work lies before us in this weed control problem. The importance of fundamental research is also to be kept in mind, if any large-scale use of chemicals is envisaged for weed control purposes. In fact it may be said that even in the advanced countries of the West, real knowledge on the fundamental aspects as to how exactly these hormone chemicals act on plants, to bring about such multifarious effects ranging from weed control to prolonging the cold storage life of fruits, has somewhat tended to lag behind their commercial exploitation for agricultural purposes.

The future prospect would seem to be a vigorous search for a chemical that would be as effective on grasses as 2 : 4–D is on broad-leaved weeds. The next development would be a particular best weedicide for a particular weed in a particular crop. Better formulations of herbicides to minimise spray-drift damage and increase lethal effect on weeds, are other desirable developments.

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Enzyme (Diastase) of Aspergillus oryzae and its Application to Malt Extract Production *

by

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I. **Introduction:** The method employed in the Government Malt Factory for the production of malt extract was by germinating cholam (*Sorghum durra*). Since the malted cholam contains comparatively little of the enzyme amylase, only about 20 per cent of the starch contained in the cholam grain is recovered as sugar (maltose). This tells on the cost of production of malt extract, besides the cost involved in the malting process where controlled conditions of temperature, humidity, constant attention etc., are necessary, for which special equipments in the form of air-conditioned couching chambers have to be maintained.

It has long been known that the fungus *Aspergillus oryzae* contains an enzyme of high diastatic power and, therefore, investigations on the enzymatic studies on *Aspergillus oryzae* were carried out to see its applicability to the production of malt extract. Because of its high saccharifying power (nearly four times that of malted cholam) it was hoped, that if a method was developed for the utilization of fungal diastase, the cost of production could be reduced considerably.

II. **Review of Literature:** The fungus was originally known as *Eurotium oryzae*, first being identified by Ahlberg in 1879, and later, Cohn renamed it as *Aspergillus oryzae*. O. Kellner and his pupils investigated the invertase, amylase and maltase content of it. Takamine, (1914) using wheat bran as culture medium, grew the fungus and gave the name "Taka-Koji" to it and used it as an amylo-clastic agent in fermentation industries. The chief advantage of using wheat bran instead of malt is that the cost of malt is subject to wide fluctuation according to the crop conditions. And secondly, the transformation of bran into "Taka-Koji" requires only about 48 to 72 hours while malting needs 3 or 4 times that period. Underkofler (1939) revived the idea of replacing malt with mold-bran in which the fungus elaborates the enzyme in the alcoholic fermentation of grains. Underkofler et al (1946) reported extensive commercial tests in which the yields of alcohol were as good or even better with mold-bran than with malt. The same authors (1947) reported successful commercial application of mold-bran for alcohol and syrup manufacture.

It is clear that the fungus is capable of producing diastase of very high efficiency; higher than that of barley diastase and has the added

* Paper awarded the Ramasastrulu Munagala Gold Medal on the College Day, 1954.

advantage of utilising various cheap by-products such as rice-bran, wheat-bran etc. for its growth for the production of the enzyme.

III. **Object of the Investigation:** It is known that cholam diastase is poor in comparison to barley diastase. It would certainly be advantageous to obtain diastase from the fungus and utilise it either alone or in combination with cholam diastase, whereby it might be possible to obtain greater yield of extract. Secondly, the cholam for malting should be of excellent quality. This is a factor to be considered when there is scarcity of grain with prevailing high cost. With fungus enzyme any kind of starchy flour can be used and, owing to the greater efficiency of the enzyme, the cost of production of malt extract could be reduced considerably.

IV. **Materials and Methods:** Preliminary experiments were conducted under the following heads:

(a) Selection of efficient strain of *Aspergillus oryzae* in regard to its diastatic activity.

(b) Selection of a suitable media for maintenance of the fungus.

(c) Comparing the efficiency of the two diastases, namely, cholam and fungal, after standardising the method of assay.

(d) Selecting the most suitable substrate for growing the fungus for the production of diastase.

(e) Working out the optimum conditions such as temperature, moisture, etc., for the growth of the fungus for best results.

(f) Developing a method for utilising the fungal diastase for production of malt extract.

(a) *Selection of efficient strain of fungus:* Strains possessing high diastatic activity were obtained from different places as shown in Table I below and their comparative efficiency tested.

TABLE I

No.	Details of isolate		Obtained from	Diastatic power. Lintner Units
1.	N. C. T. C.	558	Bangalore	93·63
2.	,,	598	England	87·50
3.	,,	965	England	73·48
4.	A. M. I.	16,266	U. S. A.	37·00
5.	,,	17,299	U. S. A.	53·04
6.	N. C. T. C.	595	New Delhi	123·00
7.	Isolated locally		Coimbatore	85·43

From the above test it is seen that N.C.T.C. 558 and 595 are the best and these were used in further experiments.

(b) *Selection of best media for maintenance of the fungus:* To maintain the fungus for work without deterioration of its activity a suitable medium was necessary. Standard media such as Brown's, Steinbergh's and Czapek's were tried for selecting a suitable one for the purpose. However these media were not suitable for the purpose contemplated. Therefore, a modified medium was prepared consisting of malt-extract, peptone and yeast water in addition to nitrogen, phosphate, sulphate and other mineral salts in traces.

(c) *Comparing the diastatic activity of the fungus.* (i) *Standardisation of assay technique:* The diastatic power of the fungus was estimated by three different methods, viz. (1) the method prescribed by A.O.A.C. (1935); (2) Ling's modification of Lunge and Keane's (1914) method and (3) by the method developed by Gore and Steele (1935).

Finally the A.O.A.C. method was adopted, after making certain modifications to suit the local condition, in all the experiments.

Assay in Brief: (i) *Cultivation of the fungus:* Wheat bran obtained locally from the bazaar was cleaned, dried and stored in kerosene tins. Samples of ten gram quantities were weighed out, 10 ml. of water added, sterilized, inoculated with five days old culture of the fungus grown on malt agar and incubated at 28°C for obtaining best growth in the bran. On the fourth day the diastatic activity was estimated as below.

(ii) *Extraction of the enzyme for assay:* The mold-bran (as it could be designated now) was spread on glass plate, samples of 5 gm. taken in a glass mortar, a few grams of washed sand added to it and with a small quantity of water was ground to a paste, transferred to a beaker and made up to 100 ml. to extract the enzyme. The solution was stirred frequently to disperse the enzyme uniformly in the liquid.

(iii) *Estimation of diastatic activity:* To 100 cc. of 2% starch solution kept at 55°C for 30 minutes with the addition of 5 ml. of sodium acetate buffer solution to maintain the pH at 4·8 (considered optimum for the enzyme), 3 ml. of the extracted enzyme solution were added. The flask was kept exactly for 1 hour when the enzyme action was arrested by the addition of 10 ml. of N/10 KOH solution.

The amount of maltose released by the action of the enzyme was assessed by titrating against 5 ml. of Fehling's solution and the diastatic power in Lintner units expressed by using the formula:

$\frac{1,000}{xy}$ where, x is the number of ml. of diastase solution added and y the number of ml. of the hydrolysed starch solution required to reduce 5 ml. of Fehling's solution.

V. **Results:** (i) *Comparative values of diastatic power of cholam and fungal diastases:* To test the efficacy of the fungal diastase for the production of extract it was compared with the enzyme of malted cholam.

Green cholam malt prepared in the Government Malt Factory at 65°F for 72 hours was used in the test. The values are given below:

TABLE II

	Substance	*Diastatic power in Lintner units at different temperatures*		
		28°C	40°C	55°C
1.	In Czapek's solution (mycelium)	Trace	Trace	Trace
2.	,, Liquid portion	2·01	3·23	3·77
3.	Grown on waste malt	16·55	30·54	33·71
4.	Green malt — (cholam)	14·22	26·69	34·36

The diastatic power of the fungus grown on waste malt was not greater than that of cholam malt. Other workers have reported very high diastatic power equivalent to barley malt and, hence, the reason for the low value was investigated into.

(ii) *Diastatic power of the fungus grown on rice and wheat brans with different sources of nitrogen.* The diastatic power of the fungus grown under controlled conditions on wheat bran, waste malt and rice bran with different sources of nitrogen was assessed and the results are given below:

TABLE III

	Substance	Diastatic power at 55°C 60 minutes Lintner Units
1.	Waste malt 10 gm. + 0·25 gm. Ammonium sulphate	33·71
2.	,, + 0·25 gm. Ammonium phosphate	33·71
3.	,, + 1 gm. groundnut cake	37·77
4.	,, 5 gm. + 0·5 gm. groundnut cake	51·45
5.	,, 2·5 gm. + 0·25 gm. groundnut cake	101·07
6.	Rice bran 10 gm. + 1 gm. groundnut cake	82·47
7.	,, 5 gm. + 0·5 gm. groundnut cake	56·14
8.	Wheat bran 10 gm. + 0·25 gm. Ammonium phosphate	114·18
9.	,, ,, + 1 gm. groundnut cake	140·13
10.	,, 5 gm. + 0·5 gm. groundnut cake	73·64
11.	,, 5 gm. + Rice bran 5 gm.	125·54

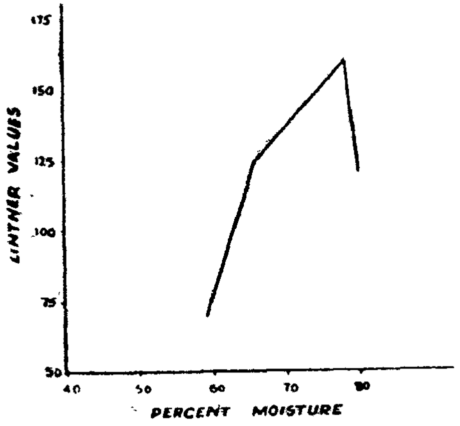
The following conclusions are drawn from the data obtained.

(1) The diastatic power of the enzyme produced by the *Aspergillus oryzae*, is far superior to that of cholam malt. The former is three to four times greater than that of the latter.

(2) Of all the substrates tried for the growth of *Aspergillus oryzae*, wheat bran has proved itself to be the best consistently in point of producing diastase of very high power.

GRAPH i

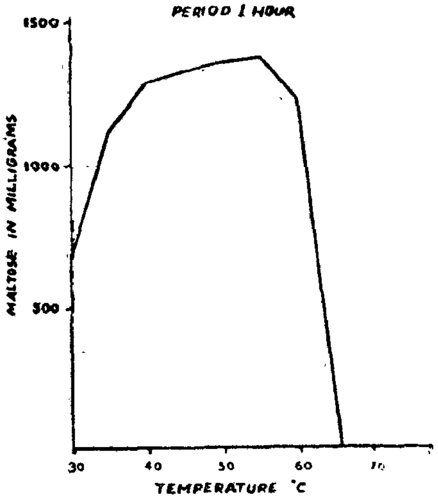
MOISTURE IN RELATION TO ACTIVITY OF THE ENZYME AT 55° 1 HOUR



GRAPH ii

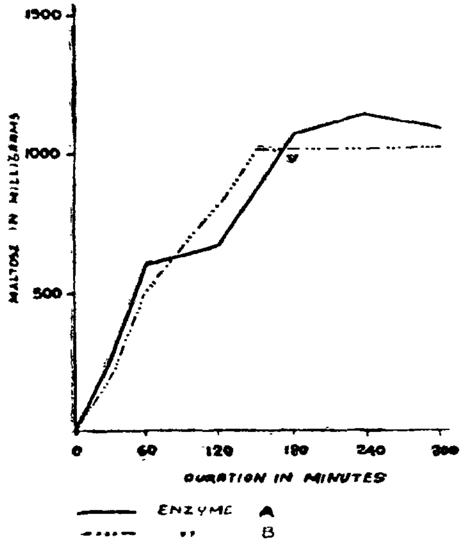
ENZYME ACTIVITY IN RELATION TO TEMPERATURE

PERIOD 1 HOUR



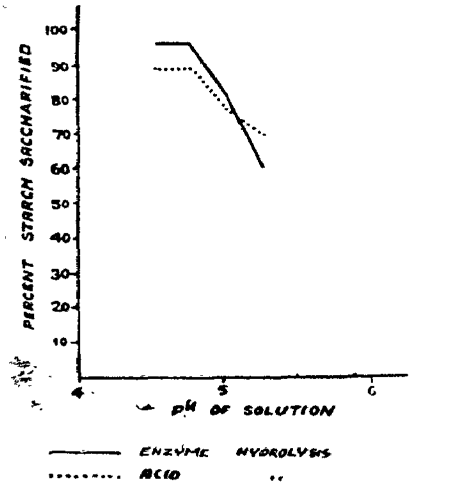
GRAPH iii

DURATION OF HYDROLYSIS & MALTOSE FORMED



GRAPH iv

COMPARATIVE EFFICIENCY OF ENZYME & ACID HYDROLYSIS



(3) The fungus makes good growth on waste malt. But, since this substance is practically three-fourths starch, the fungus utilises only a fraction of it and the rest is wasted.

(4) Rice bran as a substrate is not as good as wheat-bran Addition of wheat-bran in equal proportion increases its value.

(iii) *Utilization of other raw materials for the production of diastase:* Several previous investigators including Bindal and Sreenivasaya

(1944) have used wheat-bran, oil-cakes, cornmeal, crushed soya-bean meal etc. either as exclusive substrates or as supplements to the basal medium. Of the materials investigated wheat-bran has been found to be the substrate *par excellence* for the growth of *Aspergillus oryzae.*

For the production of enzyme a medium should be such that it will promote vegetative growth in abundance with a high diastatic content. The medium should not stimulate spore formation. Of the raw materials tried, besides wheat and rice-brans, those that have no feeding value but only valuable as fuel such as Ragi bhusa, dhall husk, groundnut shells etc. may be mentioned. They were used after pounding them to fine powder. But they do not compare favourably with wheat bran.

TABLE IV

Substrate	Lintner units
	55° – 60'
Groundnut bhusa	21·2
Ragi bhusa	15·8
Dhall husk	25·7
Ragi bhusa & groundnut cake	28·4
Dhall husk and groundnut cake	29·5
Wheat bran	82·6
Wheat bran & groundnut cake	112·4

(iv) (a) *Enzyme activity in relation to moisture content of the substrate:* To arrive at the optimum level of moisture necessary to moisten the bran for the best activity of the fungus; to 10 gm. portions of wheat bran in conical flasks water was added in varying amounts, sterilised and after the flasks were inoculated with fungal spores, they were incubated for 7 days at 28°C. The enzyme was extracted at the end of the period and its activity measured.

TABLE V

Enzyme activity in relation to moisture content of substrate

Moisture %	Lintner units 30 min. 55°C	Lintner units 60 min. 55°C
58	21·43	70·70
60	24·08	82·50
65	44·85	125·54
70	56·42	140·24
75	58·75	150·07
78	62·41	159·50
80	60·80	122·60

The activity of the enzyme is represented in graph I. The activity increases upto 78% moisture and drops at higher levels. Therefore it is clear that the bran should be moistened to 75 to 78 per cent level for the best elaboration of the diastase.

(b) ***Enzyme activity in relation to time : (temperature constant.)*** To find out how long the hydrolysis should be continued at a constant temperature for the maximum activity of the enzyme so that the greatest amount of starch could be saccharified.

A set of flasks containing 100 ml. of 2% starch solution was kept at 55°C. in a thermostat and the pH was adjusted to 4·5 by adding 5 ml. of sodium acetate buffer. The enzyme action was arrested at the specified period by adding 10 ml. of N/10 KOH solution and the maltose formed was estimated by the usual method. The results are given in Table below.

TABLE VI

Duration of hydrolysis and maltose formed at 55°C

Duration in minutes	*Maltose formed in mgm.*	
	Enzyme from sample A	Enzyme from sample B
30	275	245
60	600	519
120	653	818
180	1080	1013
240	1141	1019
300	1120	1025

From the data it is clear that the rate of saccharification is found to increase with the increase in time. The enzyme activity was practically same after three hours. The rate and course of action were almost identical when two different strains were used (vide graph iii).

(c) *Enzyme activity in relation to temperature:* Experiments with a view to find out the optimum temperature at which maximum of enzyme action takes place was carried out as below.

A set of flasks containing 100 ml. of 2% starch solution was adjusted to pH 4·8 and kept at temperatures varying from 30 to 70°C. for 1 hour and the maltose formed was estimated.

TABLE VII

Enzyme Activity in Relation to Temperature

(Period—1 hour)

Temperature °C	Lintner units 55°C 60 min	Maltose mgm.
30	76·2	700
35	125 9	1,157
40	142·2	1,306
45	146·9	1,350
50	149·4	1,373
55	152·0	1,396
60	137·7	1,266
65	trace	98
70	nil	nil

The activity of the enzyme increases steeply at first and steadily after 35°C. with the increase in temperature upto 55°C. and then declines rapidly. (vide graph ii). The maximum activity is thus seen to be around 55°C.

(v) *The effect of hydrogen-ion concentration of the substrate and enzyme activity.* It is well known that the optimum activity of the enzyme depends on the hydrogen-ion concentration of the solution with which it reacts. In order to select the level of pH of the solution for optimum activity of the enzyme an experiment was carried out and the data are given below. Side by side the acid hydrolysis of starch is given for comparing the efficiency of the enzyme with the acid hydrolysis.

TABLE VIII

pH of starch solution	Starch present	*Enzyme hydrolysis*			*Acid hydrolysis*		
		(a)	(b)	(c)	(a)	(b)	(c)
5·5 enzyme	6·741	4·574	4·117	61·07	5·208	4·687	69·54
5·0 ,,	,,	6·175	5·558	82·45	5·883	5·294	78·36
4·5 ,,	,,	7·265	6·539	96·98	6·822	6·001	88·98
4·0 ,,	,,	7·265	6·539	96·98	6·822	6·001	88 98
4·0 (control)	,,	Nil	Nil	Nil	—	—	—

(a) Sugar as maltose—gm.; (b) Starch equivalent—gm.
(c) Starch saccharified—%.

The maximum activity of the enzyme is between pH 4·0 and 4·5. At these pH, by the enzyme hydrolysis the saccharification is 96·98% while, by the acid hydrolysis it is only 88·98%. Thus it is seen that the activity of the enzyme is greater than that of the acid between pH 4 and 4·5. (Graph iv).

(vi) *Activators in relation to enzyme activity.* Some organic and inorganic substances such as amyl alcohol, ethyl alcohol, glycerol and iron, copper, manganese and zinc as catalysts were tried in small amounts as activators to speed up and enhance the activity of the enzyme.

No marked activity was noticed due to addition of the activators though there were differences among the several reagents tried in regard to their influence.

(vii) *The duration of fungal growth in relation to its activity:* To find out when the fungus attains its maximum activity in regard to the enzyme, the two strains of the fungus were cultivated on malt-agar and their activity measured daily from the 3rd to 6th day. The results are given below:

TABLE IX

Isolate		3rd day	4th day	5th day	6th day
N. C. T. C. 558	A	105·5	111·4	98·6	86·2
	B	112·57	114·5	75·6	85·4
N. C. T. C. 595	A	118·4	163·9	159·0	122·6
	B	138·9	161 5	150·1	119·5

(Values in Lintner units)

The diastatic power between third and fourth day is maximum and falls markedly later in both the cases.

VI. **Studies on the Utilisation of the Enzyme**: *Utilisation of mold-bran for the preparation of malt extract.* The saccharifying capacity of the mold-bran on the starch present in cholam, was examined as below.

Preparation of Mold Bran: The mold-bran was prepared by cultivating the strain selected for its best growth and high enzyme activity, namely isolate No. 595, on sterilised moistened wheat-bran to which 10% of groundnut cake was added. The fungus was allowed to grow in a dark place at room temperature for three days by which time the maximum of mycelial growth developed. (Used on the fourth day).

A sample of cholam, known as "Patcha jonna", was ground to a coarse flour and used for the experiments reported below.

(1) *The quantity of mold-bran for maximum saccharification of the starch present in cholam:* With the idea of finding out the quantity of mold-bran required in relation to the amount of cholam consistent with the maximum recovery of sugar the following experiment was carried out.

To 10 gm. lots of cholam flour 100 ml. of water were added and raised to a boil to mash the flour,. kept at that temperature for 2 minutes, cooled to 55°C and mold bran in varying quantities added and the action of the enzyme was allowed to proceed for one hour, boiled again for a few minutes to destroy the enzyme, filtered and sugar estimated in the filtrate. The results are given below:

TABLE X

Quantity of mold-bran	% Starch saccharified
1 gram	54
2 ,,	54
3 ,,	67
4 ,,	67
5 ,,	71
6 ,,	71
7 ,,	71
8 ,,	72
9 ,,	72

The best result obtained for the least quantity of bran was for 5 gm. of mold-bran.

The next step was to adjust the pH of the mash for, though the percentage of saccharification of the added starch was very high, it fell

short of the ideal which is 100%. Hence the pH was adjusted and the results are as below:

Mash acidified to pH	Per cent starch saccharified
5·5	61
5·0	82
4·5	97
4·0	97
4·0 (Control — No enzyme)	Nil

At pH 4·0 to 4·5 maximum hydrolysis of starch took place. Hydrolysis due to acidification of mash for pH adjustment was nil.

(b) *Gelatinising the starch present in cholam and saccharification*: Gelatinising the starch by boiling the cholam flour mash for a short while gave nearly three and a half times increased saccharification.

	Percent starch saccharified
Un-cooked	24·73
Gelatinised (cooked)	86·02

VII. **Practical Application of the Enzyme for Production of Malt Extract**: Preparation of malt extract with mold-bran was attempted as given under.

(1) *Method*: One pound of cholam, ground to a coarse flour, was cooked in water to gelatinise the starch, the mash kept at 55°C, pH adjusted to 4·5 with N/10 sulphuric acid and half-a-pound of mold bran (3 days growth) added. The hydrolysis was continued for 3 hours. After hydrolysis the liquid portion was separated by filtration through a muslin cloth and enough lime water to neutralise the sulphuric acid and precipitate it as sulphate of lime, was added (litmus test). Then 2 gm. of activated carbon for every 100 ml. of filtrate was added and filtered through activated carbon. The clear fluid was concentrated to a thick syrup of specific gravity 1·40 by evaporation under reduced pressure. The consistency of the extract, colour, flavour etc., were all perfect in every respect but there was slight bitterness in taste.

(2) *Bitterness and its removal*: The cause of bitterness was traced to the wheat bran. Apparently it contains some bitter principles that is responsible for the taste. The following experiment was carried out with a view to removing the bitterness in the final extract.

(i) Wheat bran cooked in 5 times its weight of water, the water discarded and the bran washed several times.

(ii) Wheat bran shaken for 1 hour in a shaking machine with 5 times its weight of water, the water thrown out and the bran washed well in several changes of water.

(iii) Wheat bran soaked in 5 times its weight of water overnight, the water thrown out and the bran washed in several changes of water.

The wheat-brans receiving pre-treatment as stated above were used in separate lots as substrate for growing the fungus and used for saccharification.

It was noticed that the extract obtained from the above treatments were all free from bitterness. Hence the simplest of the treatments, namely, soaking the wheat-bran in water over-night, removing the water and washing the bran in several changes of water was adopted as the best method. But, wheat bran when washed did not support the best growth of the fungus. An experiment was carried out to remedy this defect as per plan below:

Treatments.

(a)	Wheat bran		not washed (control)
(b)		,,	plus 10% groundnut cake
(c)		,,	washed
(d)		,,	washed plus 10% groundnut cake
(e)		,,	washed plus 1% starch.
(f)		,,	washed plus 1% groundnut cake plus 1% starch.

The diastatic power was determined in the usual way and the following conclusions arrived at —

(i) Washing the bran prior to inoculation considerably reduced the diastatic power. This was due, mostly, to the poor growth of the fungus on washed bran.

(ii) The poor growth in the washed bran is presumably due to the removal of starch from the bran, since, the addition of starch restored the activity of the fungus.

(iii) Probably the growth promoting factors if any that were lost by washing were available to the same extent in the added cholam flour to support best growth.

(3) *Final method evolved to produce malt-extract:* Laboratory scale preparation was attempted by finalising the method of malt extraction as outlined below: To the washed wheat bran 1% of cholam flour was added, the fungus cultivated and this bran was used for saccharification of cholam flour. The cleaned cholam was slightly roasted, ground into a coarse flour, water (five times that of cholam) added, mashed after boiling for a while at 55° C. and the mold-bran (3 days growth) added. After three hours of hydrolysis the liquid was filtered through activated carbon. To the filtrate, small quantity of sodium bicarbonate solution was added. The hydrolysate was made neutral by the addition of calcium hydroxide (litmus test) and filtered and evaporated under vacuo. The extract produced in this way had a transparent amber colour, sweet taste and pleasant aroma. With

the knowledge and experience gained by these preliminary studies, semi-pilot scale preparation of the extract was made from cholam flour successfully which had excellent keeping quality.

Summary and Conclusions: A method for utilising fungal enzyme (diastase) for the preparation of malt extract in place of germinated cholam, with a view to reducing the cost of production of malt extract, was developed, and it was found that the fungal diastase can very well replace cholam malt for the production of extract. The fungus is cultivated easily on cheap by-products like wheat bran and no laborious or time consuming process is involved in the method. The cost of production comes to about a third of the method that had been employed in the malt factory. The extract prepared was fine in all respects and kept well for a considerable time. The studies revealed that the fungal enzyme can, therefore, be utilised for the production of extracts on a large scale at a cheap cost.

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Symposium:

Recent Advances in Agricultural Extension Work

Abstract of the speech delivered by

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Within the past few years and consequent on the intensive methods for growing crops, extension work in Agriculture has seen some rapid and remarkable progress in Madras. One most note-worthy feature in the development is the supply of improved seed. Formerly the Department used to distribute a large quantity varying from eight thousand to ten thousand tons of primary and secondary seeds to ryots. This took a long time as well as considerable expense in procurement of secondary seeds. An important improvement made in the past few years by the Director of Agriculture was the supply of high grade paddy seeds and distribution to Village Seed Farms. In this method, only primary seed is multiplied by the Department and procured. This seed is distributed to selected members of the Agricultural Associations formed in each important village at the rate of one pound per acre and the entire quantity so produced is distributed by arrangement among the members of the Association, so that the whole village is covered by the improved seed, for each season. This method has the advantage of spreading the entire village in a very short period, as with one pound of primary seed it is possible to distribute 40 to 50 pounds to the Secondary Village Seed Farms. The method has got also the advantage that only high grade primary seed is handled by the Department, and the entire village is covered within three years from the nucleus seed, instead of four years and more now taken.

A similar development in Extension Work has also taken place in the direction of organising growers. For this purpose, the Agricultural Department has formed an Association for every important village and so far sixteen thousand villages have formed Village Agricultural Associations out of a total of twenty thousand villages in the State. By this method it has been possible to have full association of growers in all agricultural extension work. It is particularly the object of the Government of India, as well as the Government of Madras that Associations of Agriculturists are encouraged to distribute improved seeds. The method of Village Seed Farms for paddy and millets utilises the services of Agricultural Associations fully for this purpose, and the work is done extensively over a wide area, as well as intensively in each village. With a small quantity of seed, like two thousand tons, it is possible to develop the entire villages, where formerly ten thousand to twelve thousand tons

were required. This rapid development in quality as well as efficiency of distribution of improved seed has been a special feature of the recent advances in Agricultural Extension in Madras State.

The most significant feature of the recent advances in agricultural extension is the large amount of work involved and its turn-over. In Madras, the target for Sesbania as green manure was one million acres this year, and the achievement nine lakhs of acres, while the target for next year is one and half million acres, for which seed supply has already been programmed. Similarly, the target for ammonium sulphate is one and half million acres. Such large scale attack on agricultural improvement has been brought about by a careful planning in advance in the production side, followed by distribution and organisation in the villages. The work done on green manure in Madras to cover one million acres more every year is unique and has not been done anywhere in India or in any other country. A similar work is being done on *Glyricidia maculata,* which in the past few years has been extended to over five million plants, while every year three million plants are being arranged and systematically developed by the Agricultural Department.

This large extension on agricultural work through millions of acres has been rendered possible by the system of fixing up targets. which is also a recent development, consequent to the intensive production schemes. These targets are not only drawn up for the whole State, but for every unit and for every member of the staff to whom the targets are distributed so that the work can be watched and executed. Recently, the development has been given a very intensive shape and even village targets have been fixed up for such items as improved seed and distribution of Seed of Sesbania and *Glyricidia maculata.* In Tanjore Extension scheme, where the staff has been intensified at the rate of one Demonstrator for each Firka, instead of one Demonstrator per taluk, the work is expanding rapidly. Against a target of 730 villages, seed has been distributed to cover 700 villages individually, and this is also a remarkable feature of the recent advances in Agricultural extension.

Another feature is the large scale extension work being done in plant protection. This is particularly due to the availability of very useful insecticides like BHC and DDT and partly also to the organisation of the Plant Protection staff of the Agriculturat Department, to help the District and taluk staff in campaigns against paddy pests and diseases. During this year, insecticides and fungicides amounting to nearly 1,500 tons have been distributed and applied over an area of two lakhs of acres, Such an area has never been covered in any year before and this large scale attack has been rendered possible both by efficiency of organisation as well as the extension staff. In Madras another step of improvement is the 'forecast' service. Weekly forcasts of pests and diseases are

received from over 200 workers, and compiled by the Mycologist and Entomologist for taking prompt remedial measures. These forcasts are occasionally published in the Dailies but it will be useful if they are broadcast through the Radio.

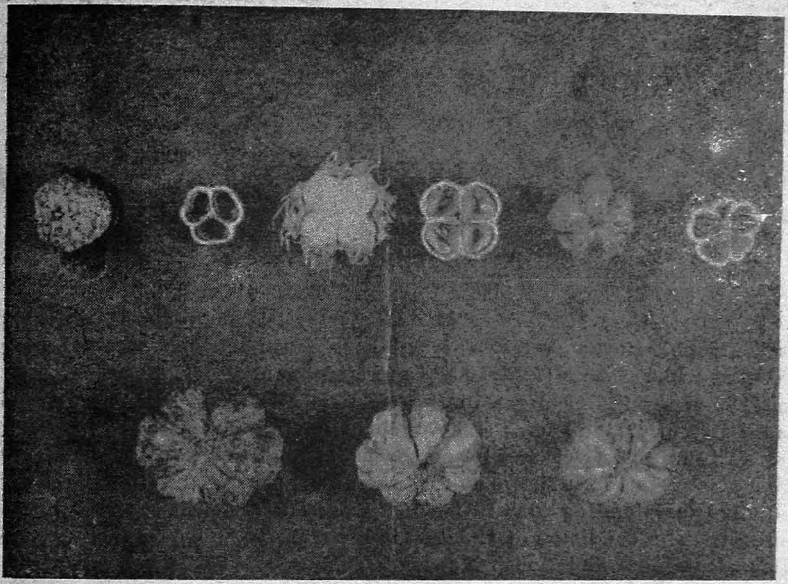
Much of the success is due to the intensification of these methods, and increasing the efficiency of work with the resources on hand. For this purpose, a planned programme of seed supply, as well as distribution is necessary. In the case of *Prosopis juliflora*, a very useful hedge plant, fifty thousand pounds of *Prosopis* was bought by the Department and this has been arranged to be distributed with the co-operation of the Railways, the Highways Department and the ryots over a very wide area. For expansion, twenty thousand miles of road and rail margins and about twenty thousand acres in the fields have been planetd to serve as fencing, as fuel and also as soil conservation plant. This plant, *Prosopis juliflora*, has got a large utility and the expansion of this plant over a wide area is due to the recent advances in Agricultural extension work.

The general trend in agricultural extension work is now towards greater efficiency in quality. Intensification of work through villages and large scale extended programme through organisation, is brought about with a minimum quantity, but over a maximum area in the shortest time. The recent advances, especially in *Sesbania*, *Glyricidsa* and *Prosopis* have all been made possible in the past few years because with a small quantity of seed, the ryot can be made to cover the whole of his area in a short time and become self-sufficient. Future work should also aim at the maximisation of work to every individual unit in a short period of time, so that the entire area is covered by agricultural improvements.

Research Note

Occurrence of Multi-Locular Fruit in *Ricinus communis*, L. (Castor)

The family Euphorbiaceae is characterised by its superior syncarpous pistil, usually three-celled and occasionally 3 or 4 celled ovary. Because of the generally three-carpelled condition this family comes under the order Thicoecae. *Ricinus communis* belonging to Euphorbiaceae has also generally three carpels with three styles and six stigmatic branches. The fruit is a schizocarp dividing into three cocci. Masur (1933) in the course of breeding work on castor, recorded 2, 4 and 5-celled fruits and observed that such cases were rare.



1. Top row — 3, 4 & 5 - carpelled fruits with cross section.
2. Bottom row — 6, 7 & 8 - carpelled fruits.

The authors of this note in the course of their study on castor came across a few multi-cellular fruits having 4, 5, 6, 7 and 8 carpels (vide figure). The number of stigmatic branches noted in these cases, was found to be double the number of carpels of the fruit, i.e., in a seven carpelled ovary fourteen stigmatic branches were noted. An extensive study revealed that the presence of multi-carpellary fruits was not confined to any particular type or variety. It was noted in many varieties of castor wherein one or two stray fruits alone were multi-locular while the rest were all normal three-loculled fruits. The seeds from these multi-locular capsules though normal in appearance, were slightly smaller in size. The plants raised from the seeds extracted from these multi-cellular fruits did not inherit this character.

Tho exact cause for the occurrence of multi-carpellary fruits is not known. The sub-tribe Acalypheae under which *Ricinus* is kept, has a few genera which have four carpels and *Maçaranga* six carpels. While the occurrence of six carpels in *Ricinus* is explainable, the presence of 7 and 8 carpels is rather baffling. *Hura crepitans* of Euphorbiaceae alone has many carpels.

Acknowledgement is due to Sri D. Daniel Sundararaj, Assistant Lecturing and Systematic Botanist, Coimbatore for help in the preparation of this note.

Agricultural Research Station, Tindivanam Dated 15—5—1954.

M. BHAVANI SHANKER RAO.
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CROP AND TRADE REPORTS

Crop Statistics, 1953—'54, Madras State, Pepper — final forecast: The area under pepper in the districts of Malabar, South Kanara and the Nilgiris is estimated at 1,18,650 acres (1,02,000 acres in Malabar District, 16,500 acres in South Kanara District and 150 acres in the Nilgiris District). Compared with the estimated area of 1,14,900 acres (1,00,000 acres in Malabar District, 14,800 acres in the South Kanara District and 100 acres in the Nilgiris District) for the previous year, the present estimate shows an increase of 3·3 per cent. Compared with the previous five years ending with 1951—'52 the present estimate shows an increase of 17·6 percent. The condition of the crop is reported to be below the normal in the Districts of Malabar and South Kanara. The yield is estimated at 9,010 tons of black pepper (7,750 tons in Malabar District, 1,250 tons in South Kanara District and 10 tons in the Nilgiris District). Compared with the yield of 8,300 tons of black pepper (7,170 tons in Malabar District, 1,120 tons in South Kanara District and 10 tons in the Nilgiris District) estimated for the previous year, the present estimate shows an increase of 8·6 percent. Compared with the previous five years ending with 1951—'52 the current year's estimate reveals an increase of 12·2 percent. The wholesale price of black pepper per standard maund of 82-2/7 lb. or 3,200 tolas as reported from important market centres on 6th March 1954 was Rs. 220—6—0 in Mangalore, Rs. 214—4—0 in Cochin, Rs. 213—8—0 in Kozhikode and Rs. 205—12—0 in Tellicherry. Campared with the prices which prevailed in the corresponding period of the last year (i. e. on 7th March 1954) these prices reveal a a decrease of 40·5% in Mangalore, 40·7% in Cochin, 40·1% in Kozhikode and 42·1% in Tellicherry.

Bengalgram — Third and final forecast: The area sown with Bengalgram in Madras State in 1953—'54 is estimated at 6,400 acres. Compared with the actual area of 6,200 acres for the previous year and the average area of 5,200 acres for the previous five years, the present estimate shows an increase of 3·2% and 23·1% respectively. The increase in area this year is mainly due to favourable seasonal

conditions. The crop is not grown in the districts of Chinglepu, Tanjore, Malabar, South Kanara and the Nilgiris. An increase in area is estimated in the districts of South Arcot, North Arcot, Coimbatore and Tirunelvelly and a decrease in the district of Ramanathapuram. The area was the same as that of the last year in Salem, Tiruchirapalli and Madurai Districts. The crop has been harvested in most of the districts. The yield per acre in the current year is estimated to be higher than that of last year in all the districts of State. The seasonal factor for the State as a whole works out to 96 percent of the normal as against 75 percent of the normal estimated for the previous year. On this basis the yield is estimated at 1,200 tons. Compared with the estimated yield of 1,000 tons for the previous year and an average yield of 800 tons for the previous five years, the present estimate shows an increase of 20·0 percent and 50·0 percent respectively. The wholesale price of Bengalgram per standard maund of 82-2/7 lb. or 3,200 tolas on 8—5—1954 was Rs. 24—1—0 in Salem. Compared with the price which prevailed in the corresponding period of the last year, this reveals a fall of 24·9 percent.

Redgram—Third and final forecast: The area sown with Redgram in the Madras State in 1953—'54 is estimated at 1,70,100 acres. Compared with the actual area of 1,34,500 acres in the previous year, it is an increase of 26·5 percent. Compared with the previous five years ending with 1952—'53, it is an increase of 9·5 percent. The increase in area this year is largely due to favourable seasonal conditions. The crop is mainly grown in the districts of South Arcot, North Arcot, Salem, Coimbatore and Tiruchirapalli. An increase in area is estimated in all the districts of the State except in the district of South Kanara, where the area in the current year is the same as that of last year. The area under the crop in the Nilgiris district is little or negligible. The crop has been harvested in most of the districts. The yield per acre is estimated to be higher than that of last year in all the district of the State. The total yield works out to 24,200 tons (cleaned gram) as against 15,600 tons (cleaned gram) estimated for the previous year and an average of 18,100 tons (cleaned gram) calculated from the previovs five years ending with 1952—'53 representing in increase of 55·1 percent and 33·7 percent respectively. The wholesale price of Tur dhall per standard maund of 82-2/7 lb. or 3,200 tolas as reported from important market centres on 8th May 1954 was Rs. 19—0—0 in Tiruchirapalli, Rs. 18—0—0 in Tirunelveli, Rs. 17—10—0 in Salem and Rs. 16—12—0 in Vellore. Compared with the prices published in the corresponding period of last year, that is, those which prevailed on 9th May 1953, these prices reveal a decrease of 18·4 percent in Tirunelvelly, 17·3 percent in Vellore, 13·6 percent in Tiruchirapalli, and 12·1 per cent in Salem.

Tobacco—Third and Final Forecast: The area sown with tobacco in the Madras State in 1953—'54 is estimated at 49,000 acres. Compared with the actual area of 45,000 acres for the previous year and the average area of 45,200 acres calculated for the five years ending with 1952—'53 the present estimate shows an increase of 8·9 percent and 8·4 percent respectively. The increase in area this year is due mainly to better seasonal conditions. The area estimated is the same as that of last year in the districts of South Arcot, and Tanjore, and an increase in the other districts of the State except in Chingleput, Malabar and the Nilgiris districts where the area is little or negligible. The crop has been harvested or is being harvested in parts of the State. The yield per acre is estimated to be higher than that of last year in all the districts of the State. The total yield works out to 28,400 tons of cured leaf as against 19,400 tons of cured leaf estimated for the previous year, representing an increase of 46·4 percent. Compard with the average yield of 20,500 tons calculated for the five years ending with 1952—'53 the present estimate is an increase of 38·5 percent. The wholesale price of tobacco per

standard maund of 82-2/7 lb. or 3,200 tolas as reported from imporant market centres on 15th May 1954 was Rs. 39—6—0 in Erode and Rs. 63—5—3 in Tiruppur. Compared with the prices which prevailed on 18th May 1953, these prices reveal an increase of 6·7 percent in Tiruppur and a decrease of 4·0 percent in Erode.

Sugarcane—Fourth and final forecast: The area planted with sugarcane in the Madras State during 1953—'54 is estimated at 1,16,500 acres. Compared with the final area of 80,290 acres for the previous year and an average area of 96,780 acres calculated for the five years ending with 1952—'53, this is an increase of 45·1 percent and 20·4 percent respectively. A decrease in area is estimated in the district of Malabar and an increase in area in the other districts of the State except in Tirunelvelly where the area estimated is the same that of the last year. The area under the crop is little or negligible in the district of the Nilgiris. The crop has been harvested or is being harvested in many districts. The yield per acre is estimated to be higher than that of last year in all the districts of the State. The total yield works out to 3,076,360 tons of cane, the gur equivalent of which is 3,37,230 tons as against 19,42,410 tons of cane with a gur equivalent of 2,14,400 tons estimated for the previous year representing an increase of 57·3 percent. Compared with an average yield of 23,86,520 tons of cane with a gur equivalent of 2,61,820 tons calculated for the five years ending with 1952-'53, the present estimate shows an increase of 28·8 percent. The average wholesales price of Jaggery per maund of 82-2/7 lb. or 3,200 tolas at important market centres on 8th May 1954 was Rs. 17—2—0 in Mangalore, Rs. 15—10—0 in Salem, Rs. 14—10—0 in Tiruchirapalli Rs. 13—2—0 is Erode. Compared with the prices which prevailed in the corresponding period of the previous year, these prices reveal a fall of 36·7 percent in Tiruchirapalli, 37·0 percent in Mangalore, and 20·9 percent in Salem.

Potato—Second Forecast Report: The potato crop is grown mainly in the Nilgiris district and to a small extent in Salem and Madurai districts.

The area under the crop upto 25th May 1954, is estimated at 23,300 acres. Compared with the final area of 20,050 acres for the previous year, this shows an increase of 16·2 per cent.

Winter Crop: The area under the winter crop of potato is estimated at 4,550 acres as against the final area of 4,030 acres for the previous year, representing an increase of 12·9 per cent. The yield per acre is estimated to be higher than that of the previous year in the districts of Salem and the Nilgiris. The Seasonal Factor for the State as a whole works out to 99 per cent of the normal as against 90 per cent estimated for the previous year. On this basis the total yield works out to 14,190 tons as against 11,370 tons estimated for the previous year, representing an increase of 42·8 per cent.

Summer Crop: The area under summer crop is estimated at 18,750 acres as against the final area of 16,020 acres for the previous year, representing an increase of 21·1 per cent. An increase in area is estimated in the districts of Madurai and the Nilgiris. The area under the summer crop in the Salem district being little or negligible. The condition of the standing crop is reported to be generally fair.

The wholesale price of potato per standard maund of 82 2/7 lb. or 3,200 tolas at Madras on 15—6—1954 was Rs. 16—8—0. Compared with price which prevailed in the corresponding period of the previous year (i. e. on 15—6—1953), this is a decrease of 21·8 per cent.

Weather Review — For the month of August, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	2·8	— 1 8	16·9
	Tirurkuppam*	5·5	+ 0·6	19·2
	Vellore	2·9	— 2·8	18·9
	Gudiyatham*	7·0	+ 2·7	28·6
East Coast	Palur*	5·0	— 0·5	21·4
	Tindivanam*	5·4	+ 1·0	25·2
	Cuddalore	5·9	+ 1·1	25·0
	Nagapattinam	2·7	+ 0·4	14·6
	Aduturai*	8·0	+ 3·4	19·7
	Pattukottai*	12 8	+ 9 5	32·0
Central	Salem	6·8	+ 0·2	23·9
	Coimbatore (A. M. O.)*	1·6	+ 0·2	15·3
	Coimbatore	0·7	— 0·5	17 5
	Tiruchirapalli	7·6	+ 3·8	20·8

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	12·4	+ 8·3	25·8
	Pamban	0·8	+ 0·2	12·7
	Koilpatti*	2·4	+ 0·2	21·6
	Palayamcottai	0·3	— 0·4	10·7
	Ambasamudram*	0·4	£	19·9
West Coast	Trivandrum	6·1	— 0·6	41·9
	Fort Cochin	14·2	+ 0·3	97·5
	Kozhikode	21·1	+ 4·0	126·5
	Pattambi*	12·0	— 1·0	76·4
	Taliparamba*	27·6	+ 5·4	136·4
	Wynaad*	16·7	+ 3·7	67·5
	Nileshwar*	31·8	+ 8·5	158·2
	Pilicode*	31·5	+10·1	145·3
	Mangalore	26·7	+ 1·2	129·5
	Kankanady*	27·7	+ 4·4	129·9
Hills	Kodaikanal	6·7	— 0·3	41·8
	Coonoor*	4·4	+ 0·4	34·6
	Ootacamund*	4·8	— 0·2	26·2
	Nanjanad*	14·3	+ 6·5	45·9

Note :—1. * Meteorological Stations of the Madras Agric. Dept.

2. £ Actual deviation is + 0·04″.

The month began with fairly wide-spread rains along the West Coast and localised showers in Mysore, Andhradesa and Tamilnad. On the third day a depression formed in the Bay about 200 miles east of Calingapatam. In the subsequent three days the monsoon was active along the West Coast. On 7-8-1954 a shallow depression was noticed over North-west Bay of Bengal with its central region about 80 miles South-east of Puri. There was no large change in the behaviour of the monsson till 11-8-1954, when it became feeble along the West Coast. It revived its vigour again on 14-8-1954 and remained so for a week. Again on 21-8-1954 it became weak. The fourth week of the month passed off with no major change in the behaviour of the monsoon. The monsoon strengthened in Central Bay of Bengal on 28-8-1954. Along the West Coast it was fairly active during the remaining four days of the month causing widespread rain in the locality and bocalised showers elsewhere in the region.

The note-worthy rainfalls and the zonal rainfall for the month are furnished hereunder :—

Note-worthy Rainfalls for the Month

Date	Name of Place	Rain-fall	Name of Zone	Av. rain-fall for July	Dep. from normal	Remarks
1/8/54	Kozhikode	4·0″	North	4·6	— 0·3	Just below normal
2/8/54	Mangalore	3·4″	East Coast	6·6	+ 2·5	Above normal
6/8/54	Mercara	6·8″	Central	4·3	+ 0·9	Just above normal
13/8/54	Tiruchirapalli	4·0″	South	3·3	+ 3·6	Above normal
28/8/54	Cuddalore	3 0″	West Coast	21·5	+ 1·1	Above normal
31/8/54	Bellary	4·0″	Hills	7·6	+ 0·4	Above normal

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore, 10—9—1954

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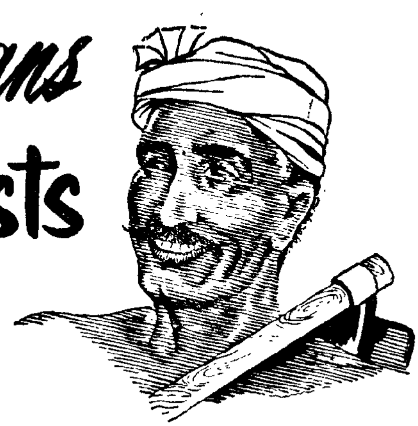

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Packing	80 lb. New Sealed Gunnies		
N. P. K. Paddy Mixture	12	6	6
Packing	80 lb. New Sealed Gunnies		
Improved A. P. Special Fertiliser Mixture	10	10	Nil
Packing	80 lb. New Sealed Gunnies		
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The Madras Agricultural Journal

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Editorial

Water and Agriculture: The north-east monsoon is in full swing and with incessant rains and heavy rains at that, one's thoughts naturally turn to "Water". We are at times confronted with too much of this commodity as during monsoons and floods while at other times the scarcity of the same is the limiting factor to our progress. Damages caused by the floods in the entire fertile river valley of the Brahmaputra would still be green in the minds of our readers. Loss to Governmental and private properties have thereby mounted to crores of rupees and in Assam alone the loss recently is reckoned as sixteen crores of rupees, not to speak of the animal and plant life lost in the floods. This is something which needs the attention of both the Agriculturist and the Government. With plenty on the one hand as in times of heavy rainfall and the dearth of the same at other times we have the problems which is common to every housewife, i. e. to conserve in times of plenty for the lean times to follow.

The importance of water to Industry and Agriculture cannot be overemphasized. In Industry, it takes 250 tons of water to make a ton of steel and 25 gallons of water to produce a gallon of aviation petrol. While in Agriculture, a crop of cotton needs 800,000 gallons of water and for lucerne the need is round about 326,000 gallons. Such enormous amounts of water being the requirements in Agriculture and Industry, the water problem has to be tackled first and foremost for the advancement of any country. The United Nations Economic and Social Council in their recent meeting at Geneva have therefore rightly recommended the formation of a "Water Board" in every country to tackle the numerous aspects of water conservation and utilization.

Our Governments have been alive to this important problem and since the Independence have launched out on many projects to conserve the water in times of abundance in huge reservoirs and dams. In the Madras State alone several crores of rupees have been

spent in reservoir projects since 1946. Readers of this Journal would be familiar with the large projects like the Lower Bhavani Project, Malampuzzha reservoir project, Mettur Canal Scheme and the Manimuthar reservoir project. Again, there are also the smaller projects like the Cauvery Delta Drainage Improvement Scheme, the Areniar project in Chingleput, the Walayar and Mangalam reservoir projects in Malabar. The Government of India have given great prominence to the water problem in their "Five Year Plan". Construction of nearly 4,000 tubes wells at an estimated cost of about Rs. 20 crores are fairly under way in the "Five Year Plan", all over India. The tempo of work has since been quickened and a target of 100 wells per month are being sunk. Each well thus sunk is expected to command the irrigation of nearly 400 acres of land.

But the solution of the water problem in Agriculture cannot and should not stop at the governmental level, with the implementation of these vast projects and plans. The farmers of the country have an equal, if not a greater part to play in the solution of this important problem. Prevention of floods and conservation of soil moisture are the age-old problems in which the farmer can help. Denuding of forests and trees in the land should be prevented. More and more trees have to be planted by the farmer to arrest the clouds and induce precipitation in the slack periods of rainfall. Silted up tank beds and other water basins have to be cleared and bunded up to conserve as much, if not all the water received through rains. Soil conservation through proper terracing and planting of grasses, to prevent erosion and to see that water percolates in the soil and drains slowly along water courses, instead of rushing out as floods, are all measures within the orbit of the farmers of the country.

Besides, the farmer can tap his underground water resources fairly cheaply by following the recommendations advocated by the Madras Agricultural Department in sinking filter point tube wells and by pumping up river supplies to high level fields. One thousand and seventy four filter point tube wells and six river pumping sets are now functioning in the Madras State. With the active co-operation of the farmer it should be possible to fully exploit these perennial sources of water supply so that water is no more a bottleneck to our progress in the Agriculture of the Country.

Recent Advances in Mycology and Plant Pathology

by

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The recent advances in Mycology and Plant Pathology are considered separately in view of the differences in their scope and development. The developments in these sciences from the beginning of this century have been considered.

Mycology: At the beginning of the century mycologists were busy collecting and naming the fungi in different countries. Taxonomic studies were concentrated upon and an enormous number of species of fungi has been described from all over the world. This number appears to be steadily increasing and may even outstrip the number of species of flowering plants in course of time. Alongside this development, the method of preservation and maintenance of the specimens also improved. In the beginning of the century the mycological specimens especially plant pathogens were mounted in the same manner as in the case of flowering plants. In many of the specimens so preserved the fungal sori or spores disappeared in course of time due to disturbances in handling specimens and they lost their value later. To avoid such damage, in many of the herbaria the type specimens are now kept in paper folders or covers and these are attached to the mounting boards. In addition permanent slides of the spores and diagrams of these bodies also are being maintained in some herbaria. With the advancement of the taxonomic studies the revision of the systems of classification was suggested by different schools. Phylogenetic systems of classification found favour in preference to the others in vogue.

Besides the collection of fungi, their isolation and study in pure cultures were taken up in earnest. The improvements in cultural technique developed by the bacteriologists were readily adapted by mycologists. Intensive activity on the study of the behaviour of fungi on culture media and the course of development of different types of reproductive bodies, followed. Emphasis was being laid on the phenomenon of sex in fungi. The sex organs readily distinguishable in several Phycomycetes were not clearly evident in the other groups. Harper demonstrated the existence of sex in Ascomycetes. The discovery of heterothallism in Mucoraceae by Blakeslee gave an impetus to investigations on similar lines in other fungi. The elucidation of the nuclear behaviour and the phenomena of

* Paper read at the College Day and Conference, 1954.

mitosis and meiosis enabled the proper appreciation of sexuality in fungi also, especially in the Ascomycetes and Basidiomycetes. The classic work of Craigie on rusts showed the real function of pycnia in the *Uredinales.* Buller's remarkable investigations on diploidisation, Dodge's contributions to the knowledge of the behaviour and inheritance of characters in *Neurospora,* Lindergren's and Subramanian's work on yeasts have all added considerably to our knowledge of the cytology and genetics of higher fungi.

With the acquisition of more precise information of the development of different groups of fungi, attention was focussed on the probable lines of evolutionary progress in this group. The old idea of the Phycomycetes being the lowest of the fungi and the other groups having developed from them gave way to the more rational and modern view of the different classes of fungi having evolved from different groups of lower organisms. The systematists have also realised that fungi are living organisms exhibiting variations and influenced to a large extent by the environment and that consequently the rigidity of the species concept could not be adhered to (especially the type specimen concept) and a certain latitude is necessary in fixing the limits of the species.

With the improvement of the technique of isolation and culture of fungi, more and more attention began to be devoted to the study of the physiology of fungi. The readiness with which the organisms could be grown and the possibility of raising several generations of these organisms in a short period rendered them particularly suitable for these studies. Considerable information on the nutritional requirements of fungi, the enzymes produced by them, the influence of vitamins and other growth regulating substances on their growth and reproduction have accumulated. These physiological and bio-chemical studies have resulted in the development of various industrial processes, utilising these organisms. The fermentation industries utilising different species and strains of yeasts and moulds for different end products, the production of citric acid, gluconic acid, acetone and glycerol by fermentation processes, the manufacture of food yeasts and other yeasts as sources of vitamins, fats and proteïn and manufacture of diastase from *Aspergillus oryzae* are some of the recent developments. The progress of the studies on the nutrition of fungi have resulted in the use of different fungi for the detection of deficiencies of certain micro nutrients in the soil without any laborious chemical analysis (*Aspergillus niger* for zinc, copper and manganese).

During the world war II the most revolutionary development was the discovery of *Penicillin* and *Streptomycin,* bacteriostatic products from *Penicillium notatum,* and *Streptomyces griseus* by Fleming and Florey in England and Waksman in the U. S. A. respectively. This was followed by a feverish rush described as 'mycological rush' comparable to the 'gold rush', for antibiotics. Several hundreds of species of fungi were investigated. However the results were not commensurate with the amount of energy spent. Yet the studies have resulted in giving to the world a few more useful drugs like chloromycetin, aureomycin, terramycin etc. Any way these studies have shown that the ubiquitous moulds in the soil or those that damage our fruits and food stuffs may yield some products useful to man. The early use of these antibiotics was to treat the bacterially induced diseases of man. In more recent times search is being made for antibiotics having antifungal properties also so that they may prove useful in keeping down diseases of plants too. The days of the pure mycologist are numbered. Unless he equips himself with a basic knowledge of biochemistry he will find himself a back number in no time. The investigations on fungi and their activities carried out all over the world are so numerous and so varied that it will be a hard job to keep oneself in touch with all the literature. One may be able to concentrate on particular aspects of the subject alone.

Plant Pathology: In olden days a mycologist and a plant pathologist were understood as being synonymous and we still find in India and often in England also the two terms not clearly distinguished and a plant pathologist often designated a mycologist. A plant pathologist is a plant doctor. In the earlier years most of the known crop diseases were due to fungi and this led to the impression that a mycologist or a plant pathologist were different names with the same meaning. But it is well known at the present day that diseases of plants may be caused by fungi, bacteria, viruses, flowering parasites, deficiency of nutrients etc., and that a knowledge of fungi alone will not be sufficient for a plant pathologist.

Plant pathology as we know at the present day is of recent origin and is only about 60 years old. Diseases of crops caused by fungi had resulted in untold misery and huge financial losses in the last century. The blight of potato, mildews of grapes, rusts of wheat and the rust of coffee in Ceylon are a few of the well known examples. Though the causal organisms were known the measures for combating these diseases did not develop rapidly. The use of

sulphur for combating mildew, the discovery of Bordeaux mixture in France for controlling grape-vine diseases and later the blight of potato and the effect of copper sulphate for seed treatment for the control of bunt of wheat were known. But these had not been widely adopted. The scepticism of the growers, the lack of suitable equipment and local prejudices stood in the way of widespread use of these methods. The impetus to the extended use of chemical fungicides was given by the American Department of Agriculture in the early decades of this century. The chain of agricultural and horticultural research stations established in that country has also contributed to a large volume of literature on plant diseases and their control, emanating from that country. The advances in the control of plant diseases proceeded in different directions viz., in the development of the chemical fungicides, in the breeding of crops with an eye for disease resistance and in the improvement of the equipment for the application of fungicides.

For a very long time the materials used for the control of fungal diseases consisted of compounds of sulphur, copper and mercury. The last group was mainly utilised for seed treatment as it was too poisonous, expensive and toxic for use on foliage. Copper fungicides were employed for the protection of most of the crops and sulphur for the control of the mildews and diseases of orchard crops. Though investigations were being carried out in Europe and America with compounds of various elements these three were the chief elements in use, mainly, on the consideration of cost. The great depression in the early thirties prevented any extension of the plant protection methods. The next development was in the use of organic mercurials synthesised in Germany. This aimed at the reduction of the mercury in the formulations considerably and thus brought down the cost of treatments. Further these could be used as dry seed dressing material which was easier to handle than the steeps or dips recommended earlier. The formulations of sulphur were modified to improve their efficacy. It was found that the smaller the particle size of sulphur used for dusting, the greater the efficacy of the fungicide. This knowledge led to the preparation of finer powders and the use of colloidal and wettable sulphurs. These preparations were good but more expensive.

Bordeaux mixture was the most widely used copper fungicide but its preparation was rather tedious. This stimulated the search for other compounds of copper with equivalent efficiency in controlling diseases. Copper oxychloride and cuprous oxide were used in

different formulations with satisfactory results. The World War II demanded maximisation of food production in all the belligerent countries. Therefore more attention was paid to the control of diseases of all crops. The high prices of raw products which prevailed during and after the war and still continues, enabled the growers to use fungicides freely without being afraid of the expenditure. The urge for the use of fungicides on crop plants like apple and some varieties of grapes which are injured by bordeaux mixture resulted in the testing of various organic compounds besides the usual chemicals. A wide array of such products is now being placed in the market mostly by American chemical concerns like Du Pont, Rohm and Haas, Monsanto and others. These are derivatives of organic sulphur (dithiocarbamates), organic mercury (mertholates), quinone compounds (phygon, spergon) and others. The new fungicides were good for specific purposes but did not serve as wide a range as Bordeaux mixture. But the ease with which they could be prepared and the absence of clogging of nozzles of the sprayers are responsible for making some of them popular.

Side by side with the development of the fungicides improvements in the spraying and dusting equipments were also introduced. The time-consuming operations with small sprayers and dusters are giving way to labour saving applications with mechanically more efficient dusters and sprayers either operated by hand or by power units. The design of the nozzles has also undergone considerable changes and we have now low volume sprayers, high volume sprayers, mist sprayers, swing fog machines, micron sprayers etc., all aiming at reducing the quantity of the fungicide used, wider range of application and quickness of action with no loss in efficiency or coverage of the crops. The principle of atomisation of the liquid by air blast is incorporated in some of these machines. The droplets vary in size from 80 to 100 microns or even smaller. These improvements have enabled the protection of large areas of field and plantation crops in a short time. On this account, one of the greatest difficulties experienced by planters in transporting water or liquids for the preparation of the mixtures in the difficult terrain of the plantations has been eliminated or brought to the minimum. Further, a round of treatment over the entire plantation can be completed in a limited time thus providing adequate and quick protection at critical periods. These operations are also being carried out economically so that expenditure on plant protection is reduced by the use of these modern equipments.

Another line of advance in the control of plant diseases is the evolution of disease resistant varieties and stains of various crop plants. Though it had been recognised in the last century that there were differences between varieties in regard to the damage caused by diseases, it was only after the rediscovery of Mendel's laws of inheritance at the dawn of this century that concerted attempts were initiated to breed resistant varieties. Biffen is to be given the credit of being the first to attempt at hybridisation between resistant and susceptible varieties of wheat to combat yellow rust. His attempts were crowned with success and the variety "Little Joss" was brought into being. Almost simultaneously attempts to overcome the scourge of black rust in Canada, the United States and Australia by breeding for resistance with or without the assistance of the Mendelian theory were initiated by numerous pathologists and breeders. Varying degrees of success were attained. Meanwhile the rusts also began to exhibit differences in their virulence in different tracts. Close study of this phenomenon revealed that new races of rusts exhibiting specialisation on particular varieties were being developed. Eriksson in Sweden and Stakman and his associates in the United States of America showed that *P. graminis* is made up of more than one race. Now over 200 races and biotypes of this rust alone are known each specific on certain varieties of wheat. Thus the race between the breeder and the pathogen came into full swing with success on either side at different periods. Besides the work carried out on wheat, breeding of all crops for resistance to diseases became a normal feature of many of the Agricultural Research Stations all over the world and a large number of resistant varieties in different crops, annuals and perennials have accumulated. However more often these successes have been short lived. In many cases new varieties or races of pathogens exhibiting higher virulence have developed in the meantime capable of infecting the resistant varieties. Thus the fight becomes eternal.

Besides fungi other parasitic organisms like bacteria, have now been known to cause crop diseases. E. F. Smith has the honour of being the pioneer in the study of plant pathogenic bacteria. A large volume of literature has accumulated in all the countries on various bacterial diseases affecting vegetables, fruits and other crops. The blackarm of cotton, the canker of citrus, the brown rot of potatoes and the black leg of tobacco are a few of the common bacterial diseases prevalent in our country. The

control of these diseases is being attempted on the same lines as for diseases caused by fungi.

The most significant development during the period under review is the advance made in the study of virus diseases of plants. More attention came to be given to the virus diseases after the year 1920. The plant virus diseases appear to have spread alarmingly and to have become much more prevalent in the present day. Conflicting theories of the nature of viruses themselves were prevalent for a long time and there was much of wrangling as to whether the viruses were living organisms or only inanimate proteins. The intimate relationship between the viruses and their insect vectors in certain cases was worked out in detail. The dispersal of the viruses through specific insects in certain cases and by a set of insects in others without any specialisation was brought out by the researches carried out in different parts of the world. Pathologists, entomologists and biochemists worked in teams to discover the properties and nature of different viruses. Stanley was able to isolate the tobacco mosaic virus as a crystalline nucleo protein which induced the mosaic when injected back into the healthy tobacco plants. His discovery constituted an important event in the history of virus pathology and this was eagerly seized upon and diligently followed by a group of English workers Bawden, Piere and Bernal amongst others. But still, the controversy whether the viruses are living organisms or chemical entities goes on. There is a school which is of opinion that the viruses are presumably akin to genes. Numerous viruses were being discovered on the different crop plants and these differed from one another in their host range, specificity of insect vectors, physical properties etc. This necessitated their classification in some form or other.

The earlier workers classified the viruses of different plants according to the hosts and the symptoms caused on the hosts like 'Sugarcane mosaic virus'. 'Tobacco mosaic virus' etc. This was followed by the system of classifying the viruses affecting particular genera according to the genus of the host and giving numerals to the different viruses occurring on the same host as 'Solanum virus', I, II. 'Saccharum virus', I, II, etc. Holmes in the United States of America proposed a binomial system of nomenclature for the classification of viruses. This has as its basis the symptom picture produced on the hosts. All mosaic diseases came under the family *Marmoraceae*, and the virus causing mosaic of tobaco was designated

Marmor tabaci. This classification however has not found much support among the other virologists. At the sixth International Congress of Microbiology held in Rome in 1953 the question of the nomenclature of the viruses was considered. It was decided that the use of systems of classification for and the application of binomials to viruses as a whole are undesirable and should be discouraged. (Nature 172, 620. 1954). The discovery of the electron microscope enabled the confirmation of the particulate structure of viruses. This instrument is being put into greater use for furthering the knowledge of the properties of viruses. In spite of all the extent of information available on viruses, the control of virus diseases presents a difficult problem. More reliance is placed on the search for resistant varieties of crop plants. In this attempt more and more use of the wild ancestors of the different crop plants is being made. Vigorous attempts have been in progress in fighting the degeneration (virus) diseases of potato. Stress is laid on the production of disease free seed tubers and their multiplication in isolated areas to replace the seed material in infected localities. The west of Scotland is the source of seed for England and the northern state of Maine for the Southern states of U. S. These places have been chosen because they are often free from insect vectors which help to spread the disease. The tristeza or the quick decline of orange is also attributed to a virus and is threatening the cultivation of oranges in many parts of world. Intense research in the use of different root-stocks, use of nucellar seedlings and adoption of other special horticultural practices like inarching on different root-stocks is being carried out in different continents for overcoming this disease. The swollen shoot of *Cacao* has come into prominence in recent years. It can be confidently stated that almost every agricultural or horticultural crop is affected by one or more virus diseases. Though virus diseases were known from ancient days, (breaking of tulips) more definite information about the nature of the viruses, their transmission and methods of control has accumulated only in recent years. Furthermore the differentiation of the different viruses occurring on crops is being attempted by serological tests. It has been found that when certain plants are affected by a mild form of a virus it is able to resist the infection by more virulent forms. This knowledge has stimulated the trials at immunising perennial plants (fruits) by infecting them with the mild virus. It remains to be seen how far this will become a practical method. A certain amount of success has been achieved. Chemotherapy is being employed to inactivate viruses in perennial plants. By injection of 9-aminobenzene

sulfonamide (0·05%) the virus of X-disease of peach is being inactivated. Thiouracil is reported to act as a viricide.

Following the studies on the physiology and nutrition of higher plants, the influence of various nutrient substances on the intensity of infection by pathoganic organisms were also studied. We know at present, that excess of nitrogen favours the onset of various diseases in several crops. Phosphates are known to keep down infection especially those affecting roots. Balanced application of N. P. & K. are necessary to keep down certain diseases (stemrot of rice). The role of micronutrients both on physiology of fungi and in the control of diseases caused by fungi is under extensive investigation. There are indications that zinc compounds in small doses keep down wilt diseases of cereals and others. Foliage sprays of urea and micronutrient substances are coming into vogue both as a method of supplying nutrition and for the control of certain diseases as root rot and die back of *Citrus*. The influence of manures on the incidence of virus diseases is also receiving greater attention in Europe and America. The attempts to control vascular diseases of plants through chemotheraphy has given success in some cases. The control of toxin-induced Dutch elm disease by the injection and use of 8 hydroxy-quinoline benzoate is a notable instance.

The development of the study of antibiotics produced by various microorganisms has resulted in attempts to utilise this phenomenon for the control of crop diseases. The earliest attempts were directed towards the encouragement of the growth of saprophytic moulds in the soil by the addition of humus or organic matter or green manures. These moulds either by competition or by antagonism helped to keep down the pathogenic organisms and thus reduced the incidence of diseases. The control of the scab of potato by green manuring is a notable example.

Further developments were in the direct use of the antibiotics produced by different fungi for combating crop diseases. However many of them were not fungistatic but only bacteriostatic. Actidione one of the products produced by *Streptomyces* has been reported to be efficient in the control of mildews of peas and beans. Griscofulvin is known to be absorbed by the roots and translocated to different parts of the plant rendering the latter immune from infection by specific pathogens. The antibiotic produced by *Bacillus subtilis* is also claimed to have a similar effect in preventing infection by *Alternaria solani*. These studies are however limited in extent and the adoption of the measures recommended is not within the

reach of many of the cultivators at the present time. However they indicate the possibilities of utilising these products or the direction in which future research may look for suitable fungistatic antibiotics. It may not be possible to obtain such remarkable therapeautic results with these substances on plants as in the case of human beings and animals. At present there is wishful thinking for the development of systemic fungicides. The production of systemic insecticides for the control of pests has stimulated the desiré and search for such fungicides which will, if discovered have a continued effect and will be very effective against root diseases or soil borne infection. There will not be any necessity for repeated applications of fungicides which increase the cost of plant protection. There is however one snag in this. The chemicals that are now applied remain on the surface of the plants and destroy the fungi or bacteria which may come into contact with the coated surface later or the chemical destroys the spores which are on the surface. A systemic fungicide must be able to kill the mycelium growing inside the tissues, without at the same time affecting the host cells. Since the host and the parasite belong to the same vegetable kingdom and not to different groups as in the case of insects and plants the chances of discovering an efficient systemic fungicide are not so readily attainable as in the case of insecticides.

To sum up, during this half century there has been considerable development in the knowledge of life histories of fungi, their cytology and physiology, the factors favouring their parasitism and the host parasite relationship. There has been considerable advance of the knowledge of the nature and transmission of virus diseases a new branch which has been developed only during this period. Remarkable progress is evident in the formulations of the fungicides and in the development of spraying and dusting equipments within the last decade due to the stimulus of World War II. If the same rate of progress is maintained the control of several devastating plant diseases will be rendered easy in the near future. However there are still certain groups of diseases which defy all our attempts to keep them in check as for instance soil borne diseases and root diseases. It is hoped that by the united efforts of the chemist, physiologist, pathologist and the engineer suitable methods of control will be evolved for checking these diseases at an early date.

So far the progress in plant pathology in the world has been considered. Coming to India, sustained interest in plant pathology

as we know it today was taken up only after the appointment of Dr. Butler as the Imperial Mycologist at Pusa in first decade of this century. In the early years he was reconnoitering and collecting informatian on the incidence of various fungi and diseases of crops in the country. He has done remarkable pioneering work and his book 'Fungi and disease in plants' is a standing example of the quality and quantity of work done. Some attempts were made in the selection of rust resistant wheat also at Pusa. With the establishment of agricultural departments in the various States more attention was devoted to the study of diseases of crops in the provinces. Madras and Mysore have excellent records to their credit and several diseases affecting perennial crops like *Areca*, coconut, rubber palmyra and orange were investigated and control measures evolved. In combating rice diseases, Madras has taken the lead and by persistent efforts has given to the cultivator a number of useful strains which could withstand the dreaded blast disease. Mehta's contributions to the study of rusts of wheat in India should be taken note of. After the World War II, the role of plant diseases in reducing production has been recognised by the centre and the states and special plant protection organisations have been started to help the farmer in combating the diseases affecting his crops. All this progress is not enough to meet the problem. This branch of Agricultural Research should be expanded much more. One Pathologist situated in one Institute cannot do justice in the investigation of all the diseases of the multifarious crops grown in the State. In the case of human beings constituting one species, the number of hospitals and doctors attending to the well-being of the people are so many though the number may not be considered adequate for the population. But when the crops are many and each crop has several diseases affecting it and there is little chance of communication between the patient and the doctor regarding the nature of the trouble, the necessity for a number of pathologists to tackle the disease problems of each group of crops in different regions is obvious.

In these days of specialisation it is suggested that we must follow the lead of other countries where agricultural research has advanced considerably and have pathologists for each group of crops like cereals, fruits, vegetables and so on to enable intensive research to be carried out on the various diseases peculiar to each.

The Soil Survey of Bhairavanitippa Project Area — An Irrigation Soil Survey

by

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Introduction: The soil survey of the Bhairavanitippa Project area was undertaken late in 1950 in order to find out the suitability of the soils and water for irrigation. The command area is situated in the Ceded districts of Bellary and Anantapur, far in the interior of the Deccan Peninsula without any high mountains nearby. So the area enjoys a very limited rainfall (about 20 inches per annum) and is subject to famine conditions very frequently. The Tungabadra project which is to be the salvation of the Ceded districts will not confer any benefit on this tract. The only source of irrigation in the region is the river Hagari. This is not a perennial stream and is in floods for only a few days in the year. Still, to improve the tract and to prevent famine conditions, it is proposed to harness the waters of Hagari for irrigation by throwing a dam across it just above the Bhairavanitippa village of Kalyandrug taluk of Anantapur district. The reservoir will have a storage capacity of 2,000 million c. ft. (effective capacity 1500 million c. ft.) and two irrigation channels are proposed to be taken from the reservoir one on either side of the river to irrigate a total area of about 8,000 acres.

2. **Traverse and soil survey:** In order to study the topography and the nature of the soils and to select sites for the profile pits, a traverse of the project area was undertaken. During the traverse the following characteristics were noted: (1) the surface features of the land such as flat, undulating, broken, etc.; (2) the soil-water conditions including drainage; (3) the texture of the soil such as sandy, loamy, clayey etc.; (4) the colour of the soils; (5) the depth, succession and nature of the horizons of the soil profile down to the parent rock and (6) the nature of the cropping and the natural vegetation in the tract.

During the traverse and soil survey on both sides of the river Hagari, 42 profile pits were dug to represent the typical soil types of the area and 112 samples of soil were collected for analysis in the laboratory. These soil samples were cut out from the vertical sides

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of the profile pits dug to the parent rock or the water table. Where the horizons were too deep or indistinguishable, soil samples were drawn for every six inches of the profile. The different horizons or depths of the profile were tested in the field for pH with pH paper, for alkalinity with phenolphthalein and for calcium carbonate with dilute hydrochloric acid. The colour, texture, structure, consistence, organic matter content, root penetration and salt, if any, in the horizons or depths were also noted in the field.

Samples of water from the river which is to be harnessed for irrigation were collected and brought Coimbatore for analysis. Water samples were also collected from some spring channels in the river Hagari and from irrigation tanks in the locality to get some information regarding the nature of the water used at present for raising crops.

The project area: The project area lies on both sides of the river Hagari, 6,000 acres on the left flank in the Rayadrug taluk of Bellary district and 2,000 acres on the right flank in the Kalyandrug taluk of Anantapur district. The slope of the land is generally from the alignment of the main irrigation channel (which is at the highest contour) on either side to the river Hagari. So the river forms the natural drainage channel for the area. The land is in some places uneven and broken and may have to be levelled up before irrigation can be undertaken. However, the larger portion of the tract is only gently undulating to the river. The soil consists mainly of shallow red soil, 6" to 24" in depth and sandy to loamy in texture with patches of deep red soil, black soil and mixed soil. The whole area is thinly populated.

The dry crops of the area are largely groundnut, cholam and cumbu with cotton, varagu, horse-gram etc. to a smaller extent. Under garden conditions ragi is cultivated extensively with occasional raising of tobacco, onions etc. Paddy is the main crop under wet cultivation. The natural vegetation in peromboke lands is Cassia auriculata. The leaves of this plant are used by farmers as green manure for the wetlands. Very little attention seems to be paid to dry land cultivation in the tract and no manures are used. In garden lands, sheep-penning is generally done while paddy lands receive scanty dressings of green leaves.

Geology of the Tract: The rocks of the project area consist of a granite and gneissic complex. The red soils are probably formed

from Potash felspars while the black soils are derived from Soda lime felspars. Kankar is found in all the soil types and gypsum is not present in any profile in appreciable amounts.

Hydrology: There are no wells in the dry lands of the ayacut area. A few, however, have been dug in the mixed soil and black soil areas where garden cultivation is carried on. The water table is low being below 18 ft. in most wells in September.

Drainage: Most of the dry uplands consisting of shallow red soils are porous in the lower depths and have good drainage. The mixed soils and black soils are lower down in the contour but as they have loamy sub soils, water logging is not likely on irrigation.

Erosion: The rainfall in the project area is, on the average, about 20 inches per annum. But the rain is often received as torrential falls and considerable run-off and sheet erosion of soil occur. Gullies found in many places in the tract are evidence of the damage caused.

Soils: The soils of the ayacut area may be divided into 4 groups. These are (1) shallow red soil 6 inches to 24 inches in depth and sandy to gravelly in character. This type forms the major soil of the tract. A large amount of stones of all sizes and shapes are found on the top of the soil. (2) Red soil 3 to 4 feet in depth. This type is sandy to sandy loam in character and occurs in patches on both flanks of the project area. (3) Mixed soils: These are 3 to 4 feet in depth and are found on both sides of the river where irrigation has been carried out with water from the spring channels. They are grey to black in the top 6 to 8 inches and brown to red in the lower depths. The top soil is generally a clay-loam with a loam as the sub soil. (4) Small areas of black soil of depth 3 to 4 feet occur in both the flanks of the ayacut area.

The mixed soils and black soils which have been irrigated with spring channel water from the Hagari have developed alkaline patches in some places.

3. **Laboratory Examination of Soils and Water:** In a survey to find out the irrigability or otherwise of an area, the most important analytical data required are (1) the suitability of the water for irrigation; (2) the salt content of the soil in the different horizons of the profile; (3) the texture of the soil and (4) the drainage facilities of the soil. So all the water samples and all the 112

samples of soil collected during the survey were analysed to obtain the above information. However, to obtain a complete picture of the soil types, one profile pit in each type has also been studied for fertility status, base exchange capacity and exchangeable Calcium. The following estimations were carried out:

(1) Moisture in the air dry soil.

(2) Mechanical composition such as the percentages of Clay, Silt, Fine sand and Coarse sand and the percentage of stones and gravel to fine soil of 2 mm. diameter and below.

(3) Alkalinity studies such as total soluble salts, Carbonates, Bicarbonates, Chlorides and Sulphates of Calcium, Magnesium and of monovalent metals like Sodium.

(4) pH and Conductivity.

(5) Fertility status including loss on ignition, insoluble and soluble mineral matter, total and available phosphoric acid and potash, total nitrogen and calcium.

(6) Base exchange studies consisting of base exchange capacity and exchangeable calcium.

(7) The water samples were analysed for total dissolved salts, carbonates, bicarbonates, chlorides and sulphates of calcium, magnesium and sodium and for pH.

Discussion of the analytical data: *Mechanical Composition*: The shallow red soil which forms the major portion of the ayacut area contains a high percentage of stones and gravel in all depths while the other soil types contain stones and gravel sufficient to prevent water-logging.

The fine soil passing through a 2 mm. sieve has been fractionated into clay, silt, fine-sand and coarse sand according to the International method of analysis. The shallow red soils range from sandy to clay loams, the coarser fractions varying from 50 to 92 per cent. The clay content increases slightly with depth. The mixed soil is mainly a clay loam with a preponderance of coarser fractions. The coarser fractions increase with depth. The deep are mainly sandy red soils loams with over 75 per cent of sand. The mechanical composition of the black soils would put them in the

clay group with over 30 per cent of particles of diameter, 0·002 mm. and less. The soils suspected to be alkaline range from loams to clay soils. They appear to have been formed from mixed and black soils by the accumulation of sodium salts.

The texture of the soils, especially of the shallow red soil which forms the major soil type of the project area is such that drainage will be efficient. Water-logging is not likely on irrigation except in the black soil. This forms only a negligible proportion of the ayacut area and need not be taken into consideration.

Soluble Salts: The total soluble salts are low in the shallow red soils and deep red soils, the amounts being 0·02% to 0·03% and 0·01% to 0·08% respectively. The mixed soils and soils suspected to be alkaline contain fairly high percentages of salts, the value ranging from 0·1% to 0·59%. There is no salt accumulation in any of the profiles studied.

One general feature noted with regard to the soluble salts is that they consist mainly of Sodium (mono-valent) compounds with little or no soluble Calcium salts. There is not much of Sodium Carbonate in the red soil types while Sodium Carbonate and Bicarbonate are present in the mixed and black soils and in the alkaline soils in appreciable amounts. It is a well known fact that a high amount of Sodium salts in the soil is not good for crop production, especially if the Sodium salts exist as Carbonate and Bicarbonate. Judged by the above dictum, the shallow red soils and the deep red soils are good for crop production while the other types are not good.

The pH values of the soils reflect on their soluble salt content and the nature of the salts. Except for a few of the shallow red soils and the deep red soils which have pH values between 7 and 8, all the other soils of the project area are highly alkaline. The soils reported to be alkaline have pH values between 9 and 10. There appears to be a fair amount of Calcium Carbonate in many of the soils. But the high pH induced by Sodium Carbonate and Bicarbonate renders it impossible for the Calcium Carbonate to get into soluble condition.

Base Exchange Studies: The black soil has high base exchange capacities varying from 34 to 57 milliequivalents per 100 gm. of soil. The other soil types are of medium to low base exchange

capacity, the shallow red soil which is the predominent soil type of the area having a base exchange capacity below 10 milli-equivalents.

In the case of a soil having a low base exchange capacity, the entry of Sodium into the exchange complex even in small amounts would constitute an appreciable amount of the total. That is to say, the degree of alkalinisation of the soil would be noticeable with even a small amount of exchangeable Sodium and when the degree of alkalinisation exceeds 30 per cent, the soil would become bad for crop prodution. The shallow red soil which covers about 60% of the ayacut area has a low exchange capacity and irrigation with Hagari water containing sodium salts would bring about its alkalinisation in a few years. To prevent this, organic matter must be incorporated into the soil in adequate amounts. As is well known, organic colloids have 5 to 6 times the base exchange capacity of clay and so will increase the exchange capacity. Moreover, during the decomposition of organic matter, acids are formed and this will lower the pH of the soil and bring into solution Calcium from the Calcium Carbonate of the soil. Organic matter, has also other desirable properties such as binding the loose soil and opening up heavy soils. So the incorporation of heavy doses of organic materials into the soil is advocated when irrigation is given to the soils of the project area.

In the soils of the project area, Calcium appears to be the dominant cation at present. So the soils have now a high lime status. But the picture would be different in a few years' time if Hagari water containing sodium salts is used continuously for irrigation. Gradually the Calcium of the exchange complex would be replaced by the Sodium of the irrigation water and the potentialities of the soil for crop production would become reduced. In a few years' time it would become alkalinised to such an extent that it would be unfit for cultivation. The soil will develop into a typical alkali soil. So, irrigation with Hagari water must be undertaken with caution.

Fertility Status: The soils of the project area are generally of low fertility status. Nitrogen is deficient in all the soil types. There appears to be sufficient amount of total phosphoric acid but available phosphoric acid is in deficit. Potash, both total and available, is present in adequate amounts. Total Calcium is present

in most of the soil types in good amounts, but available Calcium is low. Organic matter also is inadequate in the soils.

pH and Conductivity: The pH of the soil types has already been discussed. There appears to be only slight correlation between the Specific Conductivity values and the total soluble salts present in the soil.

Water: Hagari water taken from different locations in the river and water from the spring channels in the Hagari have been analysed.

The water from the Hagari river and from the spring channels contain considerable amounts of salts and these salts consist mainly of Sodium carbonate, bicarbonate, chloride and sulphate. Calcium and magnesium salts are present only in small amounts. As is well known Sodium Carbonate and bicarbonate are also toxic to plants. Water containing appreciable amounts of sodium salts should not be used for irrigation. The quality of irrigation water may be determined by the salt index formula of A. N. Puri (Irrigation Institute, Punjab). According to him,

Salt Index = (Total Na – 24·5) – " (Total Ca – Ca in Ca CO_3) x 4·85". All quantities refer to parts per 100,000. Salt Index is negative for good waters and positive for those unfit for irrigation. If the water from the river Hagari and the spring channels are tested with this formula, it is found that all of them are unfit for irrigation purposes. With regard to bicarbonates in the irrigation water Wilcox etal (1954) state that Eaton's conception of "residual sodium carbonate" which he defined in 1950 as $(CO_3^{--} + H\,CO_3^{-}) - (Ca^{++} + Mg^{++})$ appears to be useful for classifying irrigation waters having $H\,CO_3^{-}$ in excess of divalent cations. It is concluded that waters containing more than 2·5 me/l of "residual $Na_2\,CO_3$" are not suitable for irrigation while those containing between 1·25 and 2·5 me/l are marginal and that those containing less than 1·25 me/l are probably safe. If Hagari water is measured with this yard-stick, it is found to be unsuitable for irrigation.

Reifenberg (1947) in Palestine has found that fertilizing the soil with potash and phosphatic manures prevents the intake of sodium chloride from saline irrigation waters.

It is also a well established fact that once Sodium enters the exchange complex of the soil, it can be removed only with difficulty

with the use of costly amendments. So the use of Hagari water for irrigation purposes is open to considerable doubt.

4. **Final Conclusions and Recommendations:** From what has been seen of the soil in the field and from the analytical data obtained in the laboratory, it has been concluded that the main soil types of the ayacut area, namely, the shallow and the deep red soils, are suitable for irrigation. But the water which is proposed to be used for irrigation is unsuitable as it contains considerable amounts of Sodium salts.

Under normal circumstances, Hagari water containing appreciable amounts of Sodium salts cannot be recommended for irrigation. But under the peculiar condition obtaining in the project area where the Hagari is the only source of water and where scanty and uncertain rains frequently entail famine conditions, it is to be considered whether the project is to be proceeded with. Fortunately, the major portion of the area consists of shallow red soils with a very low salt content, excellent drainage and a natural gradient towards the river which is very suitable for providing adequate drainage. Another redeeming feature is that the water that will be impounded in the reservoir will be the flood waters of the Hagari and these may not contain so much of salts as the river water in summer which was examined by us. So the project may be proceeded with provided certain precautions and adjustments are undertaken. These are (1) the water should be used judiciouly to avoid possible dangers of water-logging; (2) the drainage system should be adequate and efficient; (3) organic matter must be incorporated into the soil in adequate amounts to build up the base exchange complex of the soil and to bring down the pH. This may be done by growing leguminous green manure crops with the application of phosphate manures and ploughing them in. The green manure seed should be inoculated with the specific bacterium before sowing, (4) salt tolerant varieties of food crops should be grown in the tract such as S. R. 26 B in the case of paddy etc. (5) The soils should be given adequate doses of potash and phosphatic manures to increase fertility and to prevent the intake of sodium salts from the irrigation water.

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Rural Economic Conditions of Coimbatore District

by

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2. STUDY OF HOLDINGS (Condensed from the original report)

Introduction: The term 'holding' merely indicates ownership of agricultural land by any person. In general the greater the number of holdings, the greater is the agricultural backwardness in the sector of agriculture. We are unable to call the holdings in our country as so many farms as is the case in Western countries, because they do not constitute independent units of land areas for planned crop production as it obtains in those countries. The existence of numerous holdings, as they are found at present, is in itself, a sign of unprogressive agriculture, so far as modern standards of agricultural production are concerned. Hence for a rapid and substantial advancement in the industry of agriculture, the nature and implications of a holding as it stands to-day in our country, have to be studied and modified to that extent that each holding shall in future connote independent farming units exactly as they are found in the Western Countries, particularly in the U. S. A.

Method of Study: The details of holdings as they exist in 7 villages situated in the neighbourhood of the College have been gathered for analysis and study. The names of the villages visited in this connection are as follows:— Vadavalli, Komarapalayam, Goundanpalayam, Perur-Chettipalayam, Singanallur, Ganapathy and Alandurai. These villages have been selected more for the convenience of visiting them and for the facilities and confidence for enquiry which it was possible to command in these villages, compared to certain others. So far as size of holdings are concerned, similar conditions exist in all the villages in this taluk, where the system of farming and resources are similar in most respects.

Number and Size of Holdings: It is usual to analyse and prepare statements for giving information on size of holdings, in two ways. One is according to the amount of assessment paid on the holding and the other according to area in acres. In the first statement, showing number according to areas, the preponderance of small sized holdings may be clearly seen, holdings below 5 acres

forming 52% of the total number. These cultivate among them more than half of the area under cultivation, which means such a large area is just on the border of subsistance farming methods and do not have scope for all round improvements in the art of production. The number between 5 to 10 acres is 23% and therefore nearly ¼ of the total. All told, about 75% of the holdings may be considered as sub-marginal, if 10 acres under dry land farming conditions may be said to be the limit for any decent holding. This is also proved by actual enquiries. One important point has to be mentioned, in this connection and that is, even though the area may be less than 10 acres or even 5 acres, if the area is under a well commanded fully by irrigation, the economic aspect completely changes. Such an area with a well gives adequate returns to keep a moderate farming family ordinarily above want. The area actually covered by these wells is less than 25% of the total cultivated area in all the villages and therefore the low economic prosperity of the majority of the holdings can be easily judged from this position.

The average size of a holding for all the villages put together according to area works out to 5·2 acres which is about one acre above the State average. The average size does not bring out the real state of affairs because, if the area under cultivation in the village is large and the number of holdings smaller in number, the average will be higher—eventhough the majority of the holdings are less than the average. It is not safe to be guided by the average, in the matter of holdings because a small holding with a well and intensive cultivation will change the picture completely, from one of poverty to reasonable prosperity whereas a small holding under dry farming conditions will form a drag in the Agricultural economy of the village. Holdings below one acre constitute about 13% but on actual enquiries, we found that nearly 25% of this comprise of house-sites and waste spaces, which do not come under cultivation and therefore such areas are not agriculturally important.

Number According to Amount of Assessment Paid: The average assessment on these lands works out to nearly one rupee per acre, since the amount per acre varies from about annas eight to one rupee eleven annas or so according to the various revenue classification of soils. Hence, similar to the percentages under areas, we find that in this classification, 60% of the holdings are between 1 and 10 rupees assessment group (Statement 2). This indicates that this group includes areas under 10 acres or in other words about 70% are shown to be in this classification also as being under 10 acres. Thus

the majority of the holdings are clearly under the grouping 'sub-marginal holdings' and therefore bring about the evils attendant on small holdings and their management.

Nature and Effects of Sub-Divisioning: The very existence of small holdings is proof of sub-divisioning in the past. The extent of this process of sub-divisioning of holdings can be judged by the percentage increase in the number of holdings from the year of resettlement i. e. 1910 to the current year 1953. The increase has been from 2,355 holdings to 3,059 or nearly 30%. An idea of the 'intensity' of sub-divisioning can be had from statement 3, which shows the number of holdings spread in one or more survey numbers of the field in the village area. Generally holdings which cover more than one survey number may be taken to be the result of more and more sub-divisioning. It is seen that the number decreases as the survey numbers increase. The increase in the survey number has also been due to acquisition or purchase of more area of land in different survey numbers, but this has been found to be to a small extent only, on enquiries made. The sale or purchase of land in all these villages has not been a regular feature and as a matter of fact, the tendency is to hold fast to land owned by every holder in spite of rise in land values.

What are called 'joint pattas' most of them, have been the result of subdivisioning of holdings, and it is a redeeming feature if the members of the family in partitioning have agreed to keep the holding in a joint fashion, without actually splitting for cultivation purposes. The process by subdivisioning of holdings will continue in the same manner as previously, resulting in not only in more holdings, but also smaller units. It is time serious thought is given to this state of affairs and very early action taken to put a stop to further subdivisioning among heirs to a property, by means of suitable legislation. The struggle for existence of a small holder is clearly seen in the different ways in which attempts are made to supplement the income, since the total income from the holding even in a normal season is not adequate to make both ends meet.

Nature and Effects of Fragmentation: Contrary to expectations, the process of fragmentation of holdings has not gone far enough to constitute a problem to be tackled immediately. The average percentage of holdings which have fragmented areas, in all the villages put together is only 8·5 and therefore may be considered

to be very low indeed (as seen from Statement 3). This has been evidently due mainly to the good sense prevailing among the holders themselves, who as far as possible avoid fragmenting of their holdings, by their own mutual adjustments during subdivisioning or at later time. There are many instances of joint cultivation and avoidance of separation of bits in a holding. In certain other areas of the State fragmentation of holdings may be greater particularly in the wetland and intensively cultivated areas of the Deltas. In other States as in Bombay, Uttar Pradesh and Punjab, fragmentation has gone on so badly that it has become a serious handicap to agricultural progress.

It is also important to work out the average fragment per holding and the average area of such fragment. It is these figures which will give us an idea of the extent to which fragmentation has been carried out. For all the villages together the average number of fragments per holding is 2·6 and the average area of each of the fragment is 5·9 acres. So far as number is concerned, (statement 4) comparatively it is not much, but the area has become small enough and any further fragmentation due to subdivisioning in future will result in smaller and smaller bits. The difficulty of working and raising crops on these bits can be clearly judged by a consideration of the distances between the fragments. They are more often situated at distances of ½ to 1½ miles. The average distance between any two may be taken to be a mile. Some are as much as 3 miles apart, located in the two extremes of the village.

General Effects on Economics of Production: The most important points to be discussed in such studies are the direct effects observed on the economics of production on these holdings, as a result of subdivision and fragmentation. Generally, it is easily understood how the smaller the size of a holding the greater the handicaps for improvements in production. But fortunately enquiries in these villages show that the ryots themselves are well aware of such consequences resulting in small holdings and therefore try to avoid as far as possible extreme subdivisioning which cannot be avoided among members of the family, though for a time the land is held in a joint patta, which indicates that there is a desire in the group for some sort of joint cultivation of the land.

Generally, we are apt to overlook one positive advantage in the possession of fragmented plots in different places of the villages. Soils and other physical conditions vary from one locality to another

and in the same village, as for example, lands situated near a river or stream or near a hill or forest area. Such portions situated in favourable localities are preferred and continued to be owned and cultivated for the scope for better or particular crops. The instance of groundnut crop suited to sandy loams nearer jungle areas has been pointed out. Owing to the variation in the nature of soils, different crops could be grown in the different seasons as for example the sowing of cholam is earlier in light soils and that of cotton is late in heavier soils. This is a positive advantage to owner of fragments in that he takes up sowings at different times and gets his income also in the same manner, provided of course, the fragmented plots in themselves are of a reasonable size for independent and economic handling.

The Economic Holding: A study of the holdings is naturally to be concluded with a discussion on the size of an economic holding. Whatever the definition that may be given to economic holding by Economists and others, the most accepted and easily understood conception will be the one that refers to the income from a holding which will keep the average family of the farmer in reasonable standards of comfort according to the locality. At any rate the income must be sufficient to keep the family above want during the whole year, if not enough to save even a little.

On enquiries of several families of farmers it is found that for a normal season and prices an area of 20 acres of dry land would be considered adequate to constitute an economic holding for a family of 4 or 5 members. If a well has been sunk and is able to supply adequate water for growing crops under irrigation, the area could be reduced to 5 under absolutely normal conditions of the season. Statement 5 gives details of expenditure and income on an economic holding suggested, and how the net income meets the requirements of the average farmers' families under conditions of simple standard of living, as obtaining in the locality and under current prices of produce.

Scope for Consolidation of Holding: It is now an established fact that the majority of the holdings in any village, are to be considered as small and uneconomic from the stand point of modern methods of farming. It will be ideal to have holdings which are not less than the economic holding size and also each one is a unit by itself, i. e. without fragmentation. This is an ideal which seems to be unattainable in the near feature, so far as our country is concerned.

However, consolidation of holdings to whatever extent that is possible will be a positive gain in agricultural development. But one has to examine first whether there is any scope for consolidation. It has been stated that the cultivators themselves are certainly aware of the evils of extreme subdivisioning and also of the advantages accruing from large units of holdings which will admit of progressive improvements for increased and efficient production. One is therefore disappointed that on enquiries one has to come to the conclusion that the scope for consolidation of holdings is not much. The owner is very reluctant to part with his portion of land, owing to factors of sentiment and attachment and being content to carry on as under present circumstances without change. But this is not to say that there is absolutely no scope for any work of consolidation. Some success can be achieved by working in a planned manner, slowly and gradually with the willing co-operation of the holders themselves. It may require enough funds for initial advancement to cultivators, who may be willing to part with their lands and which amount neighbouring holder may not be in a position to advance himself. In that way where the parties are willing attempts have to be made for consolidation of such holdings which will bring about the desired result as smoothly as possible. Which agency will move in this matter will be another question. Experiences of co-operative societies for consolidation have not been favourable at all. There should be a more powerful or rather influential body, than a co-operative society, which should come into the field. It is the Government alone that is capable of achieving any tangible results and that is why probably the Uttar Pradesh Government have taken up the matter in their hands on an all State basis recently. The next best agency would be the Village Panchayat Boards when they are properly settled for working in the villages. But they will also require proper Governmental support and guidance from revenue and agricultural officers as and when they move in this matter with enthusiasm and commendable enterprise.

Conclusion and Recommendations: 1. There is no record or register maintained by the village officers which show directly the number of subdivisions in a holding or the number of fragments. The information has to be gatherd on enquiry and given from the experience and knowledge of the Karnam or other people. It may be necessary to keep proper records to show clearly these two aspects of holdings in the villages.

2. As a result of continued gradual subdivisioning in the past, holdings have definitely become small and uneconomic, the average size being 5·16 (dry lands). This process if allowed to continue, will result in further reduction in size. A suitable Act preventing further subdivisioning has to be passed as early as possible.

3. Fragmentation has not been carried out to any serious extent, as it is only about 8% of the total holdings in the villages. But this will continue to increase, if subdivisioning is not checked. The average number of fragments per fragmented holding is 2·6, which can be considered low enough, compared to other States.

4. Voluntary adjustments of fragments are rare, but neighbouring cultivators take on lease adjacent areas for convenience and efficiency of cultivation. This has to be fully encouraged in the interests of proper land utilisation.

5. Enlargement of holdings to the limits of economic holding size, by persuasion and encouragement could be more successful in the long run, than other schemes of orthodox methods of consolidation of holdings.

6. Distances between fragmented plots are not considered a serious handicap as the plots are within reasonable distance in the village itself and due to the variations in soils and locality conferring benefits to one over the other, the advantages of fragmentation in some cases over-weigh the supposed disadvantages in the cultivation of these plots.

7. There is no voluntary effort at consolidation of holdings and the enthusiasm for such a process is practically absent among the holders. Most are just satisfied with the existing conditions and willing to carry on as at present. But in the interest of future development of agriculture and improvement as unit farms as in the west, efforts have to be made by Government to improve the position by gradual method of consolidation.

8. The size or area of an economic holding may be fixed at 20 acres for the dry lands under normal seasonal conditions, and 5 acres for a garden having well with fairly assured supply of water. It must be noted that the area of an economic holding for the dry land will increase proportionately according to the degree of failure of the seasonal rains in any year, assuming that prices of produce do not have great fluctuations from season to season.

STATEMENT No. 1.
Number of Holdings according to size in acres

S. No.	Village	Below one acre	1—3	3—5	5—10	10—15	15—25	25—50	50—100	100—250	Total	Total area of Holding	Average Holding
1.	Alandurai ..	50	146	139	169	43	44	27	8	1	617	4027	6·52
2.	Ganapathi ..	29	40	51	95	32	10	..	2	..	259	1632	6·33
3.	Kavundampalayam ..	32	119	88	82	19	12	5	..	..	357	1710	4·80
4.	Komarapalayam ..	71	121	80	48	14	6	..	..	..	340	1123	3·30
5.	Perur-Chettipalayam ..	48	87	119	128	37	8	10	1	..	438	2480	5·70
6.	Singanallur ..	51	124	64	76	24	6	11	..	..	355	2300	6·50
7.	Vadavalli ..	128	232	178	190	19	12	5	..	..	693	2510	3·60
	Total ..	409	869	719	717	188	88	58	11	1	3059	15782	5·16 (average)
	Percentage ..	13	28	24	23	6	4	2	..	..			

STATEMENT No. 2.
Number of holdings according to amount of Land Revenue paid

S. No.	Village	During Resettlement 1910							During 1953						
		Below Re. 1	1—10	10—30	30—50	50—100	100—250	Total	Below Re. 1	1—10	10—30	30—50	50—100	100—250	Total
1.	Alandurai ..	14	305	83	10	2	..	414	90	440	70	13	4	..	617
2.	Ganapathi ..	26	55	100	22	5	2	210	25	93	123	15	2	1	259
3.	Kavundampalayam ..	10	190	59	7	5	1	272	19	259	71	7	1	..	357
4.	Komarapalayam ..	32	51	110	55	37	11	296	32	72	134	56	35	11	340
5.	Perur-Chettipalayam ..	21	268	44	1	..	..	334	59	328	43	7	1	..	438
6.	Singanallur ..	40	185	57	10	9	7	308	29	202	78	26	14	6	355
7.	Vadavalli ..	68	358	88	5	2	..	521	124	499	67	3	..	..	693
	Total ...	211	1412	541	110	60	21	2355	378	1893	586	127	57	18	3059
	Percentage ..	9	60	23	4·5	2·5	1	..	12	62	19	4	2	6	

STATEMENT No. 3.

Number and distribution of fragments in Holdings

S. No.	Village	Fragments 2	3	4	5	6	7	Total	Total area	Average size of fragments	Total No. fragmented holdings	Total No. of holdings in the village	% of fragmented holdings	No. of fragments per holdings
1.	Alandurai ..	30	17	5	2	1	1	194	1746·81	9·00	76	617	12	2·5
2.	Ganapathi ..	20	5	..	..	..	..	55	368·76	6·70	25	259	9	2·2
3.	Kavundampalayam ..	25	7	1	1	..	..	80	413·39	5·17	34	357	9·5	2·4
4.	Komarapalayam ..	8	4	4	6	3	..	92	184·35	2·12	25	340	7	3·7
5.	Perur-Chettipalayam ..	19	1	1	2	..	..	55	449·27	8·17	23	438	5	2·4
6.	Singanallur ..	15	4	3	1	..	..	59	335·75	5·88	23	355	6·5	2·6
7.	Vadavalli ..	39	11	4	1	1	1	145	579·39	3·58	57	693	8	2·6
	Total ..							680	4018	..	263	3059	8·5 (average)	2·6 (average)

STATEMENT No. 4.

Areas of fragmented holdings according to sizes for all villages

	Acre crops 0—5	5—15	15—25	25—50	50 and above	
Total area of fragmented holdings in each group ..	151	1205	776	1140	748	4018 (acres)
Number of fragments ..	98	309	126	110	37	680
Average area per fragment ..	1·54	3·91	6·16	10·37	20·22	
Total number of fragments ..						263
Average area per fragment for all the group ..						5·9 acres

STATEMENT No. 5.

Size of an Economic Holding – Coimbatore Taluk – from Expenditure and Income Statement for one year (Based on prices Prevailing in September 1954 and under Normal Seasonal Conditions.)

Dry Land (Rainfed) 20 Acres

Crops – Cholam Mixed with Pulses

Expenditure :

Cost of Cultivation for 20 Acres at Rs. 75/- per acre ..	Rs.	1,500/-
Land Revenue at Rs. 1—8—0 per acre ..	,,	30/-
Interest and ohter charges ..	,,	50/-
	Rs.	1,580/-

Receipts :

60 Salagais Cholam grain at Rs. 25/- per Salagai ..	Rs.	1,500/-
Value of Straw 40 Cartloads @ Rs. 15/- per cartload ..	,,	600/-
Value of Pulses at Rs. 20/- per acre ..	,,	400/-
	Rs.	2,500/-

Net Income Rs. 2,500/- — Rs. 1580/- = Rs. 920/-

Garden Land (with well) 5 acres

Crops :

Cholam ..	2 Acres	
Ragi ..	2 ,,	
Cambodia Cotton ..	4 ,,	
Vegetables etc. ..	½ ,,	
		Area of Well, yard etc., ½ Acre

Expenditure :

Cost of Cultivation :—

Cholam ..	Rs.	270/-
Ragi ..	,,	270/-
Cotton ..	,,	900/-
Vegetables etc. ..	,,	50/-
Land Revenue @ Rs. 2/- per acre ..	,,	10/-
Interest & other charges ..	,,	100/-
	Rs.	1,600/-

Receipts :

Cotton 16 Pothis @ Rs. 115/- ..	Rs.	1,840/-
Cholam 12 Salagai @ Rs. 20/- ..	,,	300/-
Ragi 12 Salagai @ Rs. 20/- ..	,,	240/-
Vegetables etc ..	,,	50/-
Value of Straw-Cholam ..	,,	100/-
Value of Straw-Ragi ..	,,	50/-
	Rs.	2,580/-

Net Income Rs. 2,580/- — Rs. 1,600/- = Rs. 980/-

Note :— Net income of about Rs. 950/- per annum is assumed to be sufficient for a family of 3 adults and 2 children under ordinary rural conditions of living.

OBITUARY

RAO BAHADUR C. TADULINGA MUDALIAR
Retired Principal, Agricultural College, Coimbatore
Ex-Mayor of Madras Corporation

MADRAS

The news of the death of Dewan Bahadur C. Tadulinga Mudaliar, former Systematic Botanist first and Principal of the Agricultural College next, at Madras on Wednesday, the 13th October 1954 must have plunged into sorrow many of his colleagues, students, members of the Union and a considerable part of the population in Madras. Mr Mudaliar entered the Agricultural department in 1901 and retired in 1933 after putting in a long, meritorious and strenous service of 32 years. He lived upto a fairly ripe age of seven decades and a half.

Sri Tadulingam was born in October 1878, in Madras in a noble family, his brother being the late Dr. C. Natesa Mudaliar. Mr. Mudaliar distinguished himself as a clever botanist by winning the first place in the B. A. Degree Examination of the Madras University in 1900. He had the good fortune to get his training under no less a person than the famous biologist Dr (later Sir) Alfred Bourne, F. R. S., and thus grew up to be an eminent Systematic Botanist. The Madras State Herbarium attached to the Agricultural College and Research Institute, Coimbatore owes a deep debt of gratitude to Sri Tadulingam who, along with the late Rangachari, built it up to its present magnificent level. Sri Tadulingam was also a popular teacher all through his service and was very much loved by one and all of his students for all the qualities of his head and heart.

Sri Tadulingam was made the Principal of the College, a post which was rarely given to an Indian in those days and he retired as Principal in 1933 as one of the most popular officers of the Department. Sri Tadulingam was a Samaritan, to use the biblical expression, and there was not a soul in the College Estate, irrespective of cast or creed, or place, high or low, in the official strata, who had not enjoyed his timely help in moments of dire need. His ear and his purse were available at all times to anybody and everybody who badly needed them. A born good soul, with always a benign smile on his face, he was never known to be harsh even to his erring subordinates. After his retirement, Sri Mudaliar took a lively interest in the civic affairs of Madras City. He served as Councillor for the Chepauk division for 15 years. He was elected as Mayor in 1942. He was the President of the Co-operative Milk Supply Union, Ayyanavaram. Being of a pious disposition, he took an active part in the management and conduct of the affairs of the Ganesa Temple in the Big Street, Triplicane. Sri Tadulingam will ever be remembered for his services to the botanical world and for his golden heart.

To the surviving relations of Tadulingam's family, the Union conveys its heartfelt condolences.

May his soul rest in peace.

(S. N. C.)

Research Note

Achroia Innotata Lankella C. & T., — A New Wax-Moth Recorded in South India

Two kinds of wax-moths were, so far, recorded in South India and their bionomics and control measures have been studied in detail. One is the greater wax-moth—*Galleria mellonella,* F—the most serious pest of the honey bees and the other, the lesser wax-moth—*Achroia grisella,* F—which is almost similar to Galleria in habits, but the caterpillars are more scavengers, feeding on the debris collected on the floor-boards of bee hives.

Recently, a few moths reared out from the infested combs collected from colonies kept at Kotagiri and Burliar, on the Nilgiris, appeared to be different from the above two and were identified as *Achoria innotata lankella* C. & T., by Dr. W. H. T. Tams, British Museum (Natural History), Cromwell Road, London. A description of this new wax-moth is given in "The Entomologist" Volume LXXVI, February 1943 No. 957. So far as the status of this pest is concerned, the caterpillars are noted both inside the combs and on floor-boards of working colonies. Colonies of the dark variety of the Indian Bee—*Apis indica* F—seem to be more susceptible to the attack of this pest. Studies on the binomics of this new enemy have been taken up at the Apiary, Coimbatore.

Agricultural College, Coimbatore

V. MAHADEVAN,
Assistant in Entomology.

ABSTRACTS

1. *Pigman, W. and Finn S. B. (University of Alabama, Dental School and Medical College, Birmingham) "Attack on Dental caries" Chem and Eng. News, Vol. 32 P. 1658, 1954.*

Dentifrice which will prevent dental decay has yet to be found. Ammonia, urea and chlorophyl for which exaggerated claims have been made, have since been found to be unjustified. Among the "antienzymes" the compounds dehydroacetic acid, N-lauroyl-N-methyl-glycine and related compounds show promise. Fluorides used either topically or systemically still remain the only generally recognised practical anticaries agent. [A. M. K.]

2. *Radley J. A. "Potatoes as a crop and as an Industrial raw material" Chemistry and Industry No. 3, Page 64. January, 16. 1954.*

Prepared foods made from potatoes may be divided roughly into three groups, potato flour for indirect human food, potato flakes or cosettes for animal food and dehydrated mashed or strip potato.

Potato flour has been claimed to be more efficient than wheat flour as a dusting agent to prevent adhesion to boards etc., to have better filming properties and to impart a more favourable crust to the loaf.

Dehydrated mashed potatoes: Potatoes normally used in this work are of the non-waxy type. [A. M. K.]

3. *Verghese, E. J.* "*Manuring the coconut*" *Bull. Indian Central Coconut Committee Vol. VII No. 5 P. 157. 1953.*

Schedule of manuring (West Coast). (1) With the receipt of pre-monsoon showers in April—May, apply mineral fertiliser to supply 0·25 lb. N. 0·5 lb. P205 and 0·75 lb. K20 per tree. Seeds of a green manure plant at 20 to 25 lb. per acre are then broadcasted and covered with a light plough: (2) After maximum grouth of green manure plant, bury under by ploughing: (3) Along with green manure apply fertilisers to supply 0·25 lb. N, 0·5 lb. P205 and 0·75 lb. K20 per palm. (4) Repeat 1, 2, 3, every year. [A. M. K.]

Scientific Disagreement over Smoking and Lung Cancer

	Opinion of ERNEST L. WYNDER, Sloan - Kettering Institute, U. S. A.:	Opinion of W. C. HUEPER, National Cancer Institute, U. S. A.:
What causes lung cancer?	Cigarette smoking is the most important single external environmental factor causing lung cancer.	There is little if any medical evidence advanced in support of the cigarette theory.
Why the difference between urban and farm rates?	Greater incidence of lung cancer in urban populations than in rural parallels greater cigarette consumption in cities.	The recent alarming rise in frequency, especially among males, is causally related to local and general development of modern industry and the use of its products.
Why the different rates in different countries?	Death rates from lung cancer have increased in countries where tobacco consumption has greatly increased, and have not in countries (Iceland, for example) where consumption has not increased.	Discrepancies in incidence rates for various areas reflect differences in general types of atmospheric exposures.
Why is lung cancer more common in men than women?	Lung cancer has increased more among men, who are more frequently long term, heavy smokers, than among women. The slight increase in lung cancer among women parallels the gradual increase in smoking by women.	Effects of varying local exposures can be obliterated in the usual type of statistical data prepared for states and countries, and for different sexes and age groups.
What of the experimental evidence?	Epidermoid cancer of the skin in animals has been produced by application of cigarette smoke condensate.	The best that can be said about the experimental evidence on hand is that it indicates presence of carcinogenic agents in cigarette tar through use of hyperreactive animals.

—*Chem. and Eng. News, Vol. 32, p. 3124, 1954.* (A. M. K.)

LAUGH OR LEARN

How to Succeed Without Talent

If we are to believe everything we hear, how to succeed without talent is a widely practiced art. For those not completely in the know we attach the following check list which is offered by Harold R. Nissley, Cleveland, Ohio.

* Study to look tremendously important.

* Speak with great assurance but stick closely to generally accepted facts.

* Avoid argument. But if challenged, fire an irrelevant question at your antagonist and intently polish your glasses while he tries to answer. (If you don't wear glasses, hum under your breath while examining your finger nails)

* Contrive to mingle with important people.

* Before talking with a man you wish to impress, ferret out his remedies for local, national, and international problems. Then advocate them vehemently.

* Listen while others wrangle. Pluck out a platitude and defend it fervently.

* When asked a question by a subordinate, give him a "Have you lost your mind ?" stare until he glances downward. Then paraphrase the question and fire it right back at him.

* Acquire a capable stooge but keep him in the background.

* In offering to perform a service, imply your complete familiarity with the task. Then give it to the stooge.

* Arrange to be clearing house for all complaints. It encourages the thought that you are in control and enables you to keep the stooge in place.

* Never acknowledge thanks for your attention. This will incubate subconscious obligations in the mind of your victim.

* Carry yourself in a grand manner. Refer to your associates as "some of the boys in our office." Discourage light conversation that might bridge the gaps between boss and man.

* Walk swiftly from place to place as if engrossed in affairs of great moment. Keep your office door closed. Interview by appointment only. Give orders by memoranda. Remember, you are big shot and you don't care who knows it.

— Chem. and Eng. News, Vol. 38, 2848, 1954. (A. M. K.)

GLEANINGS

Use for Chicken Feathers : A fiber made from chicken feathers can be used as a paint brush and is claimed to be virtually identical with chinese hog bristles. The new fiber is based on keratin extracted from chicken feathers by chemical means. This is then converted into bristles following the same procedure as in other man-made fibers. Chem. and Eng. News, Vol. 32, Page 2,110, 1954 (A. M. K.)

USDA Studies on D. D. T. Carry Over in Soils : Toxic residues left in the soil from the D.D.T. applied was about the same after eight years whatever be the amount of D.D.T. applied. Average carry over in turf was 92% after two year, 43% after four years, 36% after six years and 29% after seven years. This percentage was the same whether 25 or 50 lbs. D.D.T. was applied to the soil. Chem. and Eng. News, Vol. 30, P. 3066, 1952 (A. M. K)

Chemical Extenders to Insecticidal Sprays : D.D.T. when applied as an oil-base spray is not long lasting on foliage as the oil penetrates into the foliage. If Instead of oil, a highly volatile solvent as methyl-ethyl ketone is used as chemical extenders for the insecticide, it quickly evaporates leaving a residue of the insecticide. The effect was lasting for 60 days while it lasted only for 15 days with the D.D.T. oil solution. Chem. and Eng. News, Vol. 32, Page 3259, 1954 (A. M. K.)

State Insurance Scheme to Benefit Workers : For the present the scheme aims at providing some sense of economic security to workers in the case of three contingencies, namely sickness, maturity and industrial injuries. The scheme would provide five types of benefits, medical care benefits, sickness cash benefit, maternity cash benefit, disablement cash benefit and dependants' cash benefit.

The Employees' State Insurance Corporation had been making every possible effort to complete enforcing the scheme everywhere, to apply to industrial workers which now has already covered roughly two lakh employees in Delhi, Kanpur, Punjab and Nagpur and now recently inaugurated in Bombay. Funds for the scheme would be mainly derived from contributions made by employers and employees. The scheme is a very big social security venture for the first time in independant India. [Press reports.] (A. H. S.)

The Fat Problem : The rapidly growing importance of edible fats was stressed by Sir Geoffrey Heyworth recently. He said that edible fats are rapidly growing important in the nutrition of the world population, which is for the most part increasing rapidly. This means the optimum use of land with maximum yield of nutrition units.

Edible fats constitute 78% of the total oils and fats production (animal and vegetable), with only about 13% for soap and 9% for other technical purposes. More fats are added to the diet as the level of prosperity rises and saturation point has not probably been reached anywhere.

In a recent study on the relation between in-come and fat consumption, it has been shown that *per capita* consumption of fat ranges from 7·9 lbs. per annum to 42·7 lbs. from low income levels to highest. During the past century demand per head in western Europe and U. S. has about doubled and population has also doubled, so four times as much fat is now required as in 1850. Increased supplies must now come from edible fats of vegetable origin as the rapidly increasing demand for fats cannot be met from increasing butter supplies. Since 1938 butter production has declined but the manufacture of margarine and similar products increased. World production of butter and ordinary ghee amounts to 3·3 million tons now (excluding Russia) as compared with 30·3 millions in 1938. The increase

in margarine and other similar production is likely to continue despite restrictions on their manufacture in certain countries prompted largely by agricultural interest. This usually takes the form of a colouring prohibition.

All this leads to the supremely important question, the optimum use of land. One aspect of this fundamental question is that large areas of the earth's suffaco are not suitable for the practice of a milk and meat agriculture as the equatorial forest areas of South America, Africa and Southeast Asia. But such areas are for the most part a highly suitable habitat for the invaluable oil palm, the cultivation of which, as one of the world's main sources of fat has to be developed on a large scale. It is interesting to note that the Soya beans according to the U. S. Department of Agriculture, yields 150 pounds of vegetable fat per acre of land as compared with cows 46 lbs. of butter fat. The worlds increasing need for milk and butter and ghee will ensure the dairy farmers' continued prosperity and there is no need to assume that increased production of margarine or similar products will mean reduced needs for butter and dairy products. Chem. and Eng. News 30, 1952 (A. H. S.)

CROP AND TRADE REPORTS

Crop Statistics, 1954—'55, Madras State, Ginger—First forecast: The area under Ginger crop upto 25th August 1954 in the districts of Madurai, Malabar, South Kanara and the Nilgiris is estimated at 12,770 acres. Compared with the area of 12,300 acres estimated for the corresponding period of the last year, it shows an increase of 3·2 per cent. An increase in area is estimated in the districts of Madurai, Malabar, South Kanara and the Nilgiris. The condition of the crop is satisfactory and the yield per acre is expected to be normal in Malabar and South Kanara Districts. The wholesale price of dry ginger per standard maund of 82 2/7 lb. or 3,200 tolas on 4—9—1954 was Rs. 88—8—0 at Kohzikode, Compared with the price for the corresponding period of the last year (i. e. of 5—9—1953) it shows an increase of 82·8 per cent.

Sugarcane Crop: The condition of the sugarcane crop in the Madras State is reported to be satisfactory except in parts of North Arcot where the yield of the crop is expected to be slightly below normal. In Ramanathapuram District, the yield of the crop is reported to be above normal due to favarable rains. It is too early to report on the yield of the crop in Tanjore, Madurai and Tirunelveli. The average wholesale price of jaggery per maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important market centres on 1—9—'54 was Rs. 14—10—0 in Tiruchirapalli, Rs. 18—8—0 in Cuddalore, Rs. 12—8—0 in Salem, Rs. 11—8—0 in Vellore, Rs. 11—2—0 in Coimbatore and Erode. Compared with the prices published for the corresponding period of the previous year, these prices reveal a fall of 51·2 per cent in Erode, 48·9 per cent in Vellore, 45·8 per cent in Coimbatore 41·5 per cent in Salem, 37·8 per cent in Tiruchirapalli and 35·9 per cent in Cuddalore.

Pepper—First forecast: The area under Pepper upto 25th August 1954, in the districts of Malabar, and the Nilgiris is estimated at 116—610, acres (99,220 acres in Malabar district, 17,240 acres in South Kanara district and 160 acres in Nilgiris district) as against 1,09,400 acres (94,800 acres in Malabar district, 14,500 acres in South Kanara District and 100 acres in the Nilgiris district) estimated for the corresponding period of the last year. The condition of the Pepper crop is

fair. The wholesale price of pepper per maund ot 82 2/7 lb. or 3,200 tolas on 4—9—54, was Rs. 129—8—0 for Nadam and Vatakam variety, Rs. 135—3—0 for Wynad variety at Kozikode, Rs. 158—0—0 at Cochin, Rs. 142—2—0 at Tellicharry and Rs. 160—12—0 at Mangalore. Compared with prices in the corresponding period of the previous year i. e. those which prevailed on 5—9—1953, these prices show a fall of 54·1 per cent for Nadam and Vatakkam Variety, 53·1 per cent for Wynad variety in Kozikode, 46·2 per cent in Cochin, 49·3 per cent in Tellicherry and 47·9 per cent in Mangalore.

Mesta—First and Preliminary: The area sown with Mesta (Hibiscus Cannabinus) in the Madras State upto 25th June 1954 is estimated at 1,310 acres. Compared with the area of 1,180 acres estimated for the corresponding period of last year, this is an increase of 11·0 per cent. An increase in area is estimated in the districts of Salem, Coimbatore and Tiruchirapalli and a decrease in the South Arcot district. The area estimated was the same as that of the last year in the districts of Chingleput, North Arcot, Tanjore, Madurai and South Kanara. The area under mesta is little or negligible in the other districts of the State. The yield per acre is expected to be normal in the districts of Coimbatore, Tiruchirapalli, Tanjore, Madurai and South Kanara and slightly below the Normal in other districts of the State. The seasonal factor for the State as a whole works out to 98 per cent of the normal as against 96 per cent of the normal estimated for the corresponding period of previous year. On this basis, the total yield works out to 2,400 bales of 400 lb. of dried fibre as against 2,140 bales of 400 lb. estimated for the previous year, representing an increase of 12·0 per cent.

Gingelly—First Forecast: The area under Gingelly upto 25th July 1954 is estimated at 149,900 acres. Compared with the area of 134,300 acres estimated for the corresponding period of the last year and an average area of 124,300 acres calculated for the past five years, it shows an increase in area this year due mainly to favourable seasonal conditions. An increase in area is estimated in the districts of Chinglepet, North Arcot, Salem, Coimbatore, Ramanathapuram and Tirunelvelly and a decrease in the districts of Tiruchirapalli, Madurai and South Kanara. The area is the same as that of the last year in the districts of South Arcot, Tanjore and Malabar. The acreage under the crop in the Nilgiris district is little or negligible. The increase in acrage is marked in the district of Coimbatore. (* 13,000 acres). The yield per acre is expected to be normal in the districts of South Arcot and Tirunelvelly and it is too early to report on the yield of the crop in the districts of North Arcot, Coimbatore and Ramanathapuram where sowings have just been completed. The wholesale price of Gingelly seed per maund of 82 2/7 lb. (3,200 tolas) as reported from important market centres on 7th August 1954 was Rs. 24—11—0 In Cudalore, Rs. 23—1—0 in Salem, Rs. 26—8—0 in Tiruchirapalli, Rs. 27—8—0 in Tirunelvely, and Rs. 26—8—3 in Tuticorin, Compared with the prices which prevailed on 8th August 1953, these prices show an decrease of 31·4 percent in Cuddalore, 28·3 per cent in Salem, 19·5 per cent in Tiruchirapalli and 26·9 per cent in Tuticurin.

Chillies—First and Final forecast: The area sown with chillies in the Madras State during 1953-54 is estimated at 130,900 acres. Compared with the area of 129,900 acres estimated for the corresponding period of last year and an average area of 121,800 acres calculated for the five years ending with 1951-52. this is an increase of 0·8 per cent and 7·5 per cent respectively. The Seasonal factor for ihe State as a whole works out to 97 per cent of the normal as against 82 per cent of the normal estimated for the corresponding period of last year. On this basis the total yield for the State as a whole works out to 70,000 tons of dry chillis. Compared with the yield of 57,500 tons of dry chillies estimated for the corresponding period of last year and an average yield of 55,400 tons calculated for

the five years ending with 1951-52, the present estimate shows an increase of 21·7 present and 26·4 per cent respectively. The average wholesale price of chillies per maund of 82 2/7 lb. or 3,200 tolas as reported from important market centres on 13th March 1954, was Rs. 85—6—0 in Coimbatore, Rs. 80—10—0 in Cuddalore, Rs. 78—8—0 in Tiruchirapalli, Rs. 74—12—0 in Tirunelveli, Rs. 73—15—0 in Madurai, Rs. (9—5—0 in Tuticorin and Rs. 67—10—0 in Mangalore. Compared with the prices which prevailed in the corresponding period of last year, these prices reveal an increase of 46·7 per cent in Tirunelveli, 41·3 per cent in Cuddalore, 29 4 per cent in Tuticorin and 3 8 per cent in Mangalore.

Groundnut—Second forecast: Summer Crop: Area and Yield: The area under the Summer crop of groundnut in parts of the Madras State during the five months January to May '54 is estimated at 86,800 acres. Compared with the estimated area of 77,600 acres for the corresponding period of last year and an average area of 78,000 acres calculated for the previous five years ending with 1953-54, the current estimate shows an increase of 11·9 per cent and 11·3 per cent respectively. An increase in area is estimated in the districts of Chingleput, South Arcot, North Arcot, Tiruchirapalli, Madurai and Ramanathapuram and the area estimated is the same as that of last year in the district of Tanjore. The increase in area is mainly due to favourable seasonal conditions at the time of sowings. The yield per acre is expected to be higher than that of last year in all the districts of the State. The toal yield is estimated at 71,900 tons of unshelled nuts as against 58,700 tons of unshelled nuts estimated for the corresponding period of last year representing an increase of 20·4 per cent. Compared with the average yield of 58,100 tons of unshelled nuts calculated for last five years ending with 1953-54 the present estimate shows an increase of 23·8 per cent.

Early Crop: The area under the early crop of ground nut upto 25th July 1954 in the districcts of Salem and Coimbatore is estimated at 1,58,000 acres. Compared with the area of 145,000 acres estimated for the corresponding period of last year and average arerge of 143,000 acres calculated for the last five years ending with 1953-54, it shows an increase of 9·0 per cent and 10·5 per cent respectively. The increase in area is due mainly to favourable seasonal conditions at the time of sowings. The yield per acre is expected to be higher than that of last year in Salem and Coimbatore districts. The total yield in these districts is estimated at 77,400 tons of unshelled nuts. Compared with the estimated production of 68,900 tons of unshelled nuts for the corresponding period of last year and an average yeild of 59,900 tons for the previous 5 years, the present estimate is an increase of 12 3 per cent and 29 2 per cent respectively. The wholesale price of groundnut (machine-shelled) per standard maund of 82 2/7 lb. or 8,200 tolas reported from importent market centers on 7—8—1954 was Rs. 10—6—0 in Cuddalore, Rs. 19—5—0 in Salem, Rs. 18—14—0 in Coimbatore, Rs. 18—10—0 in Tiruppur and Rs. 18—8—0 in Erode. Compared with the prices which prevailed on 8—8—1953, these prices show a decrease of 50 5 per cent in Satem, 46·8 per cent in Erode and 46 6 per cent in Cuddalore.

Weather Review — For the month of September, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	3·5	— 1·2	20·3
	Tirurkuppam*	2·8	— 3·4	22·0
	Vellore	1·1	— 5·8	20·0
	Gudiyatham*	0·4	— 3·5	28·9
East Coast	Palur*	2·9	— 2·1	24·3
	Tindivanam*	1·7	— 3·1	26·8
	Cuddalore	2·6	— 2·6	27·6
	Nagapattinam	1·0	— 2·3	15·6
	Aduturai*	1·2	— 2·3	20·9
	Pattukottai*	2 7	— 0 2	34 8
Central	Salem	1·9	— 4·2	25·8
	Coimbatore (A. M. O.)*	0·4	— 0·9	15·7
	Coimbatore	0·1	— 1·5	17·6
	Tiruchirapalli	3·5	— 0·5	24·3

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	3·0	— 1·7	28·8
	Pamban	Nil	— 1·1	12·7
	Koilpatti*	£	— 2·0	21·6
	Palayamcottai	0·1	— 1·1	10·9
	Ambasamudram*	0·7	— 0·6	20·5
West Coast	Trivandrum	4·3	— 0·2	46·2
	Fort Cochin	7·3	— 0·4	104·8
	Kozhikode	7·2	+ 0·6	133·4
	Pattambi*	5·5	— 0·7	81·9
	Taliparamba*	13·0	— 3·8	149·4
	Wynaad*	14·5	— 2·4	82 0
	Nileshwar*	13·6	+ 1·4	171·8
	Pilicode*	15·1	+ 5 2	160 4
	Mangalore	12·9	+ 3·5	142·4
	Kankanady*	14·7	+ 4·2	144·6
Hills	Kodaikanal	0·4	— 6·9	42·0
	Coonoor*	1·2	— 2·3	35·8
	Ootacamund*	1·1	— 3 0	27·3
	Nanjanad*	2·4	— 3·2	48·3

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

2. £ = Actual rainfall is 0·09″.

The month began with a vigorous monsoon in the south and east central Bay. A depression formed in the north Bay of Bengal on 2-9-1954, with its centre about 200 miles south-east of Puri. On the next day it came closer to Puri by 100 miles and on 4-9-1954 it moved away west—northwestwards. Rains were fairly widespread along the West Coast and at a few places elsewhere in the region on 4-9-1954 and 5-9-1954. Conditions continued without any large change till 7-9-1954, when they became unsettled in the north-west Bay of Bengal. Two days hence the monsoon became active along the West Coast, but its vigour abated the very next day and remained so for about five days. On 15-9-1954 the monsoon gained strength along the West Coast and kept its vigour till 24-9-1954. On 25-9-1954 weather became unsettled in the Central and adjoining north Bay of Bengal due to the formation of a depression. A deep depression was noted on 26-9-1954 about 350 miles east of Masulipatam and it intensified into a cyclonic storm on 27-9-1954, about 120 miles south-east of Visakapatnam. The monsoon withdrew from West Rajasthan on 27-9-1954. On 28-9-1954 the Bay cyclone lay over Hyderabad State. Under its influence widespread rains occurred in the Coastal Andhra desa, West Coast and at a few places in Rayalaseema, north Tamilnad and West Mysore. The last two days of the month passed off without any large change. The month ended with practically a dry weather throughout the Madras State.

The note-worthy rainfalls and the zonal rainfall for the month are furnished hereunder :—

Note-worthy Rainfalls for the Month

Date	Name of Place	Rain-fall	Name of Zone	Av. rain-fall for July	Dep. from normal	Remarks
9/9/54	Tiruchirapalli	1·5″	North	2·0	— 3·5	Far below normal
10/9/54	Mathurai	2·0″	East Coast	2·0	— 2 1	do.
17/9/54	Alleppey	3·0″	Central	1·5	— 1·8	do.
do.	Fort Cochin.	1·7″	South	0·8	— 1·3	do.
26/9/54	Madras (Meenambakkam)	1·7″	West Coast	10·8	+ 0·7	Just above normal
			Hills	1·3	— 3·9	Far below normal

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore.

C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATION

Gazetted Service — Postings and Transfers

Name and Present Post	Posted as
Abraham, P. D., Assistant Cotton Extension Officer, Madurai	Plant Physiologist, Coimbatore.
Appaji, V. K., Superintendent, Sugarcane Liaison Farm	Special District Agricultural Officer.
Francis, T. S., R. D. D., Madurai	Assistant Marketing Officer, Coimbatore.
Gonsalves, S.,	Lecturer in Mechanical Engineering, Coimbatore.
Katchapeswaran, S. S., on leave	R. D. D. Madurai
Krishnaswamy, P. N., Gazetted Assistant to the Cotton Certification Officer, Rajapalayam	Cotton Extension Officer, Madurai.
Muhammad Ali, A. M., Agricultural Engineering Supervisor, Coimbatore	Assistant Agricultural Engineer (Mechanical), Madras.

Upper Subordinates — Postings and Transfers

Name and Present Post	Posted as
Abdul Kadhir, A., A. D. Erode	Plant Production Assistant (Mycology), Tirunelveli.
Balasubramaniam, C. R., Certification Inspector, Rajapalayam	Certification Inspector, Coimbatore.
Balasubramaniam, K. R., A. D. D., Velur	Seed Development Assistant Tanjore
Jaleel—Ahammad, N., on leave	Assistant in Mycology, Coimbatore.
John Knight, A. A. D. Wallajah	A. A. D., Ambur
Kalyanikutty, T., Paddy Assistant, Pattambi	Paddy Assistant, Coimbatore.
Kuppuswamy, V. R., Seed Development Asst. Tanjore	A. A. D. Velur (Salem)
Kuttisankaran, M. P., Adl. F. M., Kulittalai	A. D. Coondapoor.

Name and Present Post	Posted as
Laxmi, A., Assistant in Mycology, Coimbatore	Assistant in Entomology, Cbe.
Mohammad Ibrahim, P. A., Coconut Nursery Assistant, Marudur	Assistant in Oilseeds, Pilicode.
Natarajan, C. P., Assistant in Chemistry	Assistant in Chemistry, Coimbatore
Paramanandam, P., Spl. A. D., Sugarcane, Karur	A. D , Namakkal.
Padmanaban, S. Soil Conservation Assistant, Kangayam Vellakoil Scheme	Soil Conservation Assistant, Dharapuram
Pattabiraman, R., Spl. A. D. Sugarcane Act, Karur	A. A. D. Erode.
Rajagopal Reddy, V., on leave	Paddy Assistant, Pattukottai.
Sankaranarayanan, C. Farm Manager, Cbe.	Seed Development Assistant Cbe.
Santhanam, S. R., Soil Conservation, Assistant, Kangayam, Vellakoil Scheme	Seed Development Assistant, Cbe.
Seshagiri Rao, T., Assistant in Chemistry, (Salem)	Assistant in Chemistry, Cbe.
Singaravelu, T. V., A. A. D , Gangavalli	Spl. A. D., Sugarcane, Karur.
Sriyan Kumar, S., Paddy Assistant, Palur	A. D. Kallakurichi
Sundaram Pillai, K., Plant Protection Asst. Mycology, Tirunelveli	A. D. Erode
Thyagarajan, S. R , Asst. in Chemistry, Cbe.	Asst. in Mycology, Coimbatore.
Venkatram, C. N., Asst.n in Ckemistry, Cbe.	Field Assistant in Chemistry.
Vittal Higdi, Y., A. D., Coondapoor	Addl. F.M., Kulitalai, Trichi Dt.

NEWS AND NOTES

Under the auspices of the Students' Club, Mr. Kenneth Farner from Idaho, U. S. A. who was at the Agriculture College, Coimbatore on the Agricultural "4 H" programme, gave a talk to the students and staff on October 20th 1954 on American Farming and his impressions of India.

The College participated in the Intercoligate zonal debates in English, Tamil, Malayalam and Kannada held at the Arts College, Salem; the Arts College, Coimbatore; Victoria College, Palghat, and at the Arts College, Mangalore, respectively.

The following students represented the College in the debates:

Students	Language
Mr. Sundaravaradan, Final year ,, William Odango do.	English.
Mr. R. M. Alagappan, Final year ,, Raja Sheriff, Second year	Tamil.
Mr. V. Kumaran, Final year ,, Narayana Pishoroti Final year	Malayalam.
Mr. B. Karunakara Shetty, Final year ,, Krishna Marla, Second year	Kannada.

The candidates failed to get selected for the final debate.

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Packing	**80 lb. New Sealed Gunnies**		
N. P. K. Paddy Mixture	**12**	**6**	**6**
Packing	**80 lb. New Sealed Gunnies**		
Improved A. P. Special Fertiliser Mixture	**10**	**10**	**Nil**
Packing	**80 lb. New Sealed Gunnies**		
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The Madras Agricultural Journal

Vol. XLI November 1954 No. 11

Editorial

Professor George B. Cressey of the Syracuse University, New York, in a recent discussion in London on world population very vividly brought home to his audience the reality of the rapid rise in world population by his comment that by the time his lecture and discussions were over in two hours the world population would have risen by six thousand. So every hour the world has an extra three thousand mouths to feed. India, therefore with approximately a seventh of the world population has proportiontely about 400 extra mouths added on every one hour of the day or night. But unfortunately our resources and expansion in food output do not keep pace with the growing population. Consequently the pressure upon the land has increased enormously to three to four thousand persons per square mile in some arable areas and the country thereby suffers from over population. There are 558,089 villages in India with a net population of 357 million, which is nearly four times that of England. And eighty percent of this population are directly dependent on Agriculture. This is more than double the population of people directly dependent on Agriculture in Western European countries. Hence India's problem of balancing resources with population is a vital one which has to be tackled sooner or later in the independent and resurgent India.

The Government of India has since Independence, set out to establish a Welfare State. When it drew up its first five year plan, production of food was given the highest priority as there could be no Welfare State without food. The Community Development Projects since initiated in October 1952 had "food receiving the primary emphasis in the initial stages of the programme." In 1953 the National Extension Service was launched with its main objective confined to the improvement of Agriculture. Thus, with the agricultural development as the chief preoccupation of the authorities in Government, India has made a start in solving the problem of feeding the growing millions. Consequent to these steps our per

capita consumption in food has since risen from the level of 1398 Calories in 1950—'51 to 1623 Calories in 1953—'54. Still we are far from the 2,500 Calories which is the recommended allowance for a 150 pound man.

Various steps are being taken by Government and non-Government bodies to mitigate the growing population and limited resources. The development of new industries and the expansion of existing ones to take redundant people off the land is the major objective of the second Five Year Plan. The first five year plan has succeeded largely in expanding the area under cultivation by reclaiming new areas, by development of irrigation facilities and bringing about an intensification in agricultural production; thus raising the output per acre. Many projects are either in the course of execution or are nearing completion.

Side by side to these technological improvements social readjustments are under way through land reforms. The objective appears to be to fix ceilings on holdings and the redistribution of the surplus land to the landless. The extent to which this policy will influence production is yet to be seen. Such a remedy to quote Sir John Russel "has not increased food output in parts of the world where such large ownerships have been abolished."

These remedies together with the far reaching policies envisaged by our Premier Pandit Jawaharlal Nehru after his recent visit to China will highlight the Second Five year plan of the country which is now in the making. The new ideas from China which have been successfully implemented and fruitfully worked out in an over populated country like China should yield tangible results in a country like ours, which has many social and economic problems in common with China.

Recent Advances in Plant Nutrition*

by

S. VENKATACHALAM & A. MARIAKULANDAI
Agriculture Research Institute, Coimbatore

Introduction: The naive view has often been expressed that the chemist has only to determine the plant food by analysis of the soil and then by subtraction from the total need of the plant one can say how much more is needed for a given crop and at this the problem of plant nutrition is solved. This is highly erroneous as only an almost trivial fraction of the total amount of any plant food in the soil is available to crops at any one time and there are innumerable complicating factors preventing the simple solution to the problem of estimating the amount actually available to the plant. Years of research has shown that the nutrition of the plant is a very complicated subject. From the time Jon Baptista Von Helmont (3) conducted his classical experiments with the feeding of the willow tree some 300 years ago to the modern times, much field has been covered in this fascinating study of plant nutrition.

Plant growth has been shown to be not merely a question of supplying the necessary mineral nutrients; but has time and again been proved in recent times to be determined by the complex environment of the plant in which the mineral supply from the soil is only one factor. There are many changes and interactions taking place in the soil which finally determine whether or not the individual nutrients will be available to the crops in suitable quantities and in the correct proportion. The recent advances made in this field could be generally classed under the following heads of study:

(1) The power of the soil to fix nutrients.

(2) Effect of other factors like organic matter, lime status etc., of the soil in plant nutrition.

Much headway has been made in recent times in improving plant growth through a study of the above factors and it shall be the object of this paper to briefly outline the advances made under each, with a brief review of the related fields.

Nutrient Fixing Capacity of Soil: By virtue of the exchange cations and anions in the colloidal fractions of a soil, a proportion of the added nutrients may be fixed in the soil. This reaction is

* Paper read at the College Day and Conference, 1954.

both an advantage and a disadvantage. It is advantageous in as much as the fixation process prevents the rapid leaching out of the nutrients from soil. It is disadvantageous in many instances as in the case of phosphorus and potash when a considerable portion of these added nutrients in the soil is never recovered by the crop due to the fixation. Acid soils and those containing free hydrated oxides of iron and aluminium present special problems in phosphatic fertilization. In such soils, these free oxides fix the phosphates by a process of absorption to such an extent that it is unavailable to the plant. The laterite soils of Malabar and the lateritic soil of Nilgiris in this State are good examples of such soils. These soils have a strong acid reaction, the pH being 5·5. On these soils, owing to their property of phosphate fixation, high dosages of phosphates are needed for a good crop. Thus in the Nanjanad manure mixture used for the potato crop, the dose of phosphate is about ten times that required in neutral soils for any good crop. About 1,000 pounds of phosphatic fertilizer in the form of super or super plus bone meal to give about 200 pounds of P_2O_5 per acre are used. Attempts were made in this State and in other countries to tackle this problem of phosphate fixation. The application of lime and organic matter in addition to super, placement of phosphate at the root zone, etc., were the outcome of such investigations. These however did not help to reduce the dosage of phosphate to be applied. Experiments at Rothamstead showed that silicates can replace the absorbed phosphate. New phosphatic materials were produced with a silicate combination and work was started in the laboratories at Coimbatore to test this silico phosphate on laterite soils. Silico-phosphate was prepared and pot tests conducted to evaluate its usefulness on the lateritic soils of Nanjanad in Nilgiris. The results of these tests showed that the availability of phosphate in the soil could be doubled by the use of the silicophosphate whereas super-phosphate failed completely in this respect (5). To confirm the findings of these tests and to evaluate their worth in terms of monetary value, large scale experiments have been planned under field conditions at Nanjanad. Better yields of potato with smaller dosage of silicophosphate than when super is applied is expected and thus it will be possible to attain a reduction in the manure bill of the potato grower. Apart from this, the production of the silico-phosphate fertilizer will bring into use the 8 million tons of Trichy phosphate deposit which has hitherto been abandoned as useless for conversion to superphosphate and which has now been found possible to convert into silicophosphate (6).

Effect of other factors like organic matter, lime status etc.: Struthers and Sieling (9) discussing the new ideas on the fixation of phosphates in soil have indicated that certain organic acid anions could form compounds with the free iron and aluminium in the soil and thereby prevent the fixation of the phosphate, thus rendering it available to plants. Of the organic acids, like citric, oxalic, tartaric and malic which were tried, the citrate ion was outstanding, with power to influence the phosphate release at a wider range of pH viz., 4–9 for aluminium phosphate and 4–6 for iron phosphate than the other acid ions.

As the fixation of phosphate is high in acid soils, lime application to change the pH was the next solution tried by many workers. Hopkins (4) has pointed out that if an iron phosphate complex has been precipitated at a pH of 4·0, a change to pH 6·0 by adding alkali will release only 7% of the phosphate, which has been fixed while the citrate ion could release 89%. And hence lime application may owe this effect not to pH change but to its ability to increase bacterial activity which ultimately results in the polyuronides and increase in organic acid ion giving an effect similar to the polymers now on the market under the patent names Krilium, Aerotil etc.

These ameliorative measures have been tried out in the laterite soils of Malabar on a field scale embodying different combinations of superphosphate, lime and green manure with paddy as the crop grown. Three years' trials showed that the maximum production of grain and straw is obtained by the application of high dosage of superphosphate at 60 lbs. P_2O_5 per acre in conjunction with liberal dosage of green leaf at 7,500 lb. of Vengai leaf (*Pterocarpus marsupium*) per acre and lime at 3,000 lb. per acre (8).

From the above two factors discussed, it will be evident that feeding plants through the soil is not a simple addition of the required nutrients but is a complicated process involving many aspects of Soil Science. The newer methods to improve the mineral status of the plant tries to obviate the effect of the soil and its reactions and comprises of the following:

(1) Foliar spraying.
(2) Chemical injections.
(3) Presoaking of seeds.
(4) Soilless cultures.
(5) Plant hormones.
(6) Isotopic tracers.

Foliar sprays: Feeding through the roots is a slow process and is often faced with complication due to the interaction of the soil on the added nutrients whereas feeding through the leaves is claimed to give immediate benefit to plants. The assimilation is said to take place within a few hours. The Monsanto Chemical Company has put on the market a product known as Folium a 20-20-20 N-P-K water soluble concentrate which is claimed to produce excellant results on vegetables, flowers and meadows. An advantage with this mode of feeding is that the dosage per acre is only a fraction of what is applied to the soil. The use of foliar sprays of urea to fruit trees is well known. The leaf feeding can be taken advantage of for the phosphate nutrition in the laterite regions.

The role of micro nutrients, the so called trace elements such as iron, copper, zinc, boron etc., in the nutrition of plants is great. Some spectacular results have been obtained with citrus and other fruit crops by applying these as foliar sprays.

Chemical injections: Injections of iron and zinc salts to fruit trees like pears and peaches have been in vogue in California to correct these deficiencies and many elegant devices and recipes for feeding plants through injections of nutrient solution have been developed in recent years. Treatment of soil only, in the absence of information derived from other techniques could easily lead to erroneous conclusions. A case in point is afforded by a study of zinc deficiency in California (2). In a peach orchard showing zinc deficiency, it was computed from results of plant analysis that the trees and fruits removed about 8 ounces of zinc in seven years; yet an analysis of the soil showed 3,000 lbs. of zinc to the acre within root zone. In another zinc deficient soil, 1.500 lbs. of zinc sulphate applied to the soil failed to cure zinc deficiency in apples. It would be easy to miss the nature of deficiency in these cases if treatment were confined only to the soil. On the other hand, the essential status of zinc was demonstrated by techniques of foliar spraying or tree injections.

Feeding the seed before sowing: Presoaking the seeds in nutrient solutions before sowing is yet another method adopted lately in the feeding of plants. Thus presoaking of potatoes with a 5% solution of potassium phosphate has been claimed to increase the yield. Under local conditions, soaking of paddy in a molar or semi-molar solution of tribasic potassium phosphate has increased the grain yield by 13%. In groundnut, 2 to 5% of monopotassium phosphate

gave increased yields to a marked extent. Pretreatment with hormone solutions like β–Indol acetic acid also increased the yields though to a lesser degree than tribasic potassium phosphate (7).

Soilless cultures: A large number of species of higher plants have been grown successfully in artificial cultures with the roots furnished only with a solution of inorganic salts under suitable conditions of root aeration. Under normal conditions, these plants which include most of the Agricultural species, are fully capable of synthesizing the organic substances which they require. There has been no evidence that plants so grown are deficient in dietary essentials.

Plant hormones: Just as certain substances are essential for regulating and controlling animal growth, certain chemicals are necessary to accelerate or alter the course of normal plant growth. These are known as plant hormones. It was discovered in 1931 that human urine contains growth promoters for plants, known as Auxins. It has been observed (1) that there exists Auxins 'a' and 'b' both chemical compounds possessing the formula $C_{18}H_{32}O_5$ and $C_{18}H_{30}O_4$ respectively and structurally very similar to human sex hormones. Hetero auxin is β-indole acetic acid which is also found in animal urine and is a useful plant hormone. β-indole buteric acid has been found to possess properties with which root development in soil is greatly exaggerated. Sulphanilamide upto the concentration of 30 parts per million in soil improves tomato production. Likewise, chloro-picrine treated soils greatly increase the yield of tomatoes and in one case 378 percent of normal yield has been reported.

Use of radioactive isotopic tracers in the feeding of plants: The use of radioactive isotopes in the study of plant nutrition is worth mentioning here as a recent advance in the feeding of plants. The use of these isotopes though not used directly in increasing the yield of crops have been of much use in the study of the methodology of plant nutrition. By the use of the isotope of a mineral in the nutrient media the intake and the distribution in the plants of the particular mineral can be followed through.

Thus, the science of plant nutrition is definitely marching forward and is gradually developing into many interesting branches. As in the other fields of Agricultural Science, there are many factors influencing the nutrition of plants which needs more and more of intensive study in the near future.

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A Passion Fruit for the Plains

by

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Introduction: Several kinds of creepers known as "passion vines" are grown for their edible fruits as well as for their ornamental flowers in India. A few of these, commonly called "the purple granadilla", "the giant granadilla", etc., have been disseminated over a number of years in certain localities and are now growing as part of the natural vegetation. Recently there has been some effort to grow one of these, viz., the purple passion fruit, commercially in South India. This purple passion fruit is an important crop in Australia, New Zealand, Hawaii and other countries and in South India it grows luxuriantly and bears heavily in Coonoor, Ootacamund, Kodaikanal, Sheveroys and other places of high altitude. It needs a mild climate and at lower altitudes the vines are found to be extremely vigorous in vegetative growth but produce very little crop. Recently an yellow fruited variety has been introduced into South India from Ceylon and investigations on this variety have shown that it is of relatively easy culture and is well adapted to the plains

and lower altitudes. It grows very vigorously, comes to fruit within a year of planting and produces an abundant crop of fruits in successive waves with little attention. Its fruits have a decidedly better flavour than that of the purple passion fruit.

Uses of the Passion Fruit: Although passion fruit has been under cultivation in India for a number of years its use is not so widespread; the fruit is acidic in taste and therefore is not much favoured for direct eating. But it lends itself excellently to be used in a number of preparations because of the peculiar aromtic pleasing flavour of the pulp, and so is much in demand in other countries. The most important of these preparations is the passion fruit squash, a very delicious product, extremely pleasing and nutritious and a most excellent drink for the summer. The squash is prepared by extracting the juice by means of pressing the pulp in a cloth and adding to the juice the calculated amount of sugar. If a chemical preservative is added, the squash will keep well for nearly two years and it should be diluted five or six times with water before use.

The fruit is also used in making various kinds of cocktails, cordials, jelly, syrup, sherbet, ice-cream, flavouring for icing, candy, cakes etc. A very satisfactory canned product may be prepared by adding the fresh passion fruit pulp to a boiling hot sugar syrup. Some of the preparations of this fruit well known in other countries are the following:

Passion fruit-coconut candy:	Prepared with passion fruit pulp, sugar and shredded coconut
Passion fruitade:	The syrup is mixed with water, poured over crake ice and taken in summer.
Fresh passion fruit punch:	A mixture of juices of passion fruit, lemon and pineapple poured over cracked ice.
Hot spiced passion fruit juice:	A mixture of passion fruit juice, sugar, water, lemon juice, clove, allspice and cinnamon is boiled and served hot with a strip of lemon peel.
Passion fruit cake icing:	Passion fruit pulp is added to butter and sugar and spread on cakes.
Passion fruit sherbet:	Passion fruit syrup is added to boiling sugar solution, egg white is added, stirred and freezed before use.
Passion fruit ice cream:	Passion fruit syrup or juice, sugar and vanilla are mixed, added to cream and freezed.

Culture of Yellow Passion Fruit: The yellow passion fruit is found to require lower altitudes and plains for best growth; the site

selected for passion fruit should be in open situations where the air will be warm and comparatively dry which is conducive for proper fertilisation of flowers.

The passion fruit is not very exacting in soil requirements. Sufficient moisture and adequate humus in the soil are important considerations. Except very heavy and poorly drained soils and soils of very low fertility, all other types can be deemed to be suitable.

The vine can be propagated by seed or cuttings. The seeds should be sown immediately after extraction in seed pans or well prepared nursery beds. In three or four months' time when the plants are about 6 to 10 inches in height they can be set out in their permanent sites. Cuttings taken from well matured wood strike roots readily and can be transplanted in about three months. Normally, rooted cuttings will come to bearing earlier than the seedlings.

The land in which the vines are to be set out should be well prepared in order that the young plants may establish themselves rapidly and develop a good root system.

The vines are grown on trellis, fence, bowers or pergolas. The relatively small amount of space required by the plants and their early fruiting habit make them suitable to be grown as intercrops with such orchard trees as require six to eight years to come to bearing. For this purpose, in foreign countries, the vines are planted along low wire-trellises constructed in the alleys between fruit trees. The plants are set out at a spacing of ten to fifteen feet. Passion fruit can also be grown in the form of a pure plantation.

Shallow cultivation to keep down weeds may be necessary as often as possible. The vines may be manured once a year with well rotten compost or cattle manure and a little of chemical fertilisers although in South India the vines rarely receive any manure. In other countries farm yard manure applied along with a mixture of sulphate of ammonia, superphosphate and sulphate of potash at 10 : 6 : 10 ratio at 4 to 8 cwt. per acre has given excellent results.

No pruning is practised in South India. But when the tops of vines become too dense, portions of the vines may be pruned. Removal of deadshoots and interfering branches may also be necessary for promoting good crop production. In Australia pruning is regularly practised to make the vines bear crops at different periods when better prices may be obtained.

The plants will come to bearing within a year of planting and in about the sixth year maximum bearing will be reached.

The fruit is borne on the new wood arising from old laterals and leaders and occasional pruning of such laterals will help in forstering such growth. The yellow variety produces spherical or oval fruits which are light yellow in colour when fully ripe. The central cavity of the fruit enclosed in a thick, leathery rind contains many seeds each surrounded with a juicy, orange coloured pulp which is quite acid and of a pleasing aromatic flavour. In certain areas of South India, this variety is found to be unfruitful under open pollination and in such cases hand pollination of the flowers with pollen from the same flowers has been found to promote good fruit set.

The vines are in fruit almost throughout the year but the bulk of the crop is produced from May to November.

The fruits are harvested after they attain the full colour of ripeness; some prefer to let the fruits ripen and fall to the ground and then collect them. If stored after the fruit has matured the shell dries up and becomes wrinkled but the pulp remains in good condition for several days. An yield of about 15 to 20 pounds (150 to 200 fruits) per year can be obtained from each plant.

No serious pests or diseases have been reported in this country on this fruit although in other countries several serious diseases and pests have caused much concern to growers.

Conclusion: The yellow passion fruit is a hardy, quick growing and early bearing crop and can withstand drought to some extents It requires less attention than many other fruits and is well suited to be grown as an intercrop in orchards- The fruits lend themselves for the prepartion of several delicious products and the crop is thus a rich source of subsidiary income to orchard owners. Till recently the fruit was confined only to the hill regions but with the introduction of this yellow variety, its cultivation can now be developed in the plains also. The plants are also highly ornamental and produce large, showy, flagrant flowers. This fruit merits large scale cultivation in all areas of the plains of South India.

Quality Control in the Manufacturing of Cholam Malt Extract

by

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Malt extract possesses high nutritive value and is easily digested. Plain malt extract is administered not only to infants and invalids but also is used in pharmaceutical industry as a vehicle for fish-liver oils and mineral salts. Imported brands of malt extract are manufactured mostly from barley. Siddappa (1) reported that malt extract manufactured from *Cholam* or *Jowar* (*Sorghum Vulgare*) compares favourably with other standard malt extracts. The quality of the malt extract depends upon the care and precision with which the several processes involved in its manufacture are carried out. This was evident while manufacturing cholam malt extract at the Government Malt Factory at Coimbatore. Based on that experience certain suggestions have been made in this paper regarding the application of the methods of quality control in the different stages of manufacture of malt extract.

1. **Selection of grains**: The first stage in quality control starts with the selection of the right type of raw material. Before bulk purchases are made, it is necessary to test the grains for their suitability for malting. Seed viability i. e., the germination capacity of the sample, is a very important measure of its suitability for malting since the yield and quality of the malt extract depend upon the percentage of germination of the seeds. This can be rapidly assessed with the chemical 2, 3, 5–triphenyl tetrazolium chloride (2). Bulk purchases should be made only after satisfying that the samples have a germination capacity of over 80% and the grains are well-developed, uniform in size and yellow in colour. Stocks stored in pits should not be purchased as they have very low germination capacity. Cholam grains generally retain their viability for about one year when they are stored in suitable godowns taking necessary precautions against any insect attack.

2. **Malting**: The manufacture of malt extract involves three stages, viz., (i) germination (ii) partial roasting at controlled

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temperature and grinding (iii) mashing and concentration. Strict control has to be exercised over all these processes to get a product of good quality. For germination, the cholam is graded, washed with lime water to free it from bitter resins and tannins present in the husk and then steeped in water for 24–30 hours, with intermittent aeration, changing the steeping water twice or thrice. The grains are then drained and couched for 5–6 days at controlled temperature of 67–69°F. Since this is a very important stage in the process, strict quality control is necessary to see that the grain absorbs the maximum amount of moisture and is well aerated as, otherwise, the germination and consequently the yield of extract will be low. Further, during germination also, proper care should be taken to see that the grains are sprinkled with the right amount of water and that the growth is arrested by drying in the sun when the acrospire is $\frac{1}{4}''$ long, which will usually take 5–6 days at 67–69°F. Although malting at ordinary temperatures may be cheaper and may give fairly satisfactory malt extract, it is to be borne in mind that vigorous enzyme formation and thorough modification of the grain will occur only when the malting is conducted at the proper controlled temperature of 67–69°F.

The sun dried malt, which is known as green malt, should be analysed periodically for its diastatic activity in terms of lintner degrees, saccharification time and cold water extract by standard methods (3) in order to ensure that the germination process is being carried out efficiently. A part of the green malt has to be roasted at 135–140°F for 3–4 hours to develop the characteristic malt aroma. This process also requires careful control. The green and roast malts are ground to a coarse flour of 40–50 mesh. Fine grinding should be avoided as it not only causes difficulties in centrifuging and filtration but also often results in impairing the keeping quality of the finished product, because fine particles of starch, that might pass through the filter, will facilitate the growth of mould in the extract during storage.

The water used for mashing should be tested before hand for freedom from metallic contamination or other substances which may affect the quality of the product. It should be of moderate hardness, containing only 20–40 parts of dissolved salts per 1,00,000 of which calcium sulphate or chloride should form the major proportion. Carbonates in excess of 1–2 parts per 1,00,000 are undesirable as they have the effect of making the reaction alkaline. When water conforming to the above standards is used for mashing, a pH

of 5·8–6·0, which is the optimum for cholam malt amylase activity, is obtained by the action of weak acids of the malt itself. The temperature of mashing also is of great importance in determining the quality of the final product and great care should, therefore, be taken to see that it is always maintained between 58–60°C. Any attempt to get higher yields of extract by resorting to mashing at higher temperatures should be avoided as they lead to an unattractive, cloudy product which has very poor keeping quality.

The thick mash left after decanting the clear liquid is generally centrifuged, and the centrifuged liquid mixed with the clear supernatant liquid and heated to about 80°C to facilitate quick filtration. The hot liquid should be filtered quickly under vacuo on a bed of activated carbon to prevent the development of an unattractive colour and high acidity in the finished product. The clear filtrate is then concentrated in vacuum stills at about 64–68°C to a final concentration of 78–82% soluble solids. The progress of concentration should be followed with the help of a suitable refractometer. Towards the final stages of concentration, the temperature should be kept below 60°C in order to avoid the development of any dark colour and caramelised taste in the extract. Every batch of the final product should be tested for uniformity of quality and, if need be, they should be blended suitably to get a standard product for the market.

The laboratory examination should consist of both organoleptic evaluation and chemical analysis. In the former case, caramelised taste and metallic flavours should be looked for. The chemical analysis should consist of the determination of (1) refractive index and total soluble solids (2) specific gravity (3) acidity (4) total proteins and (5) total reducing sugars expressed as maltose. The data should generally conform to the limits proposed by Siddappa (1) for cholam malt extract.

Refractive Index	...	1·4950— 1·5000
Total soluble solids by Refractometer at 28°C	...	80 —82%
Specific gravity	...	1·40 —1·45
Acidity (expressed as acetic acid)	...	0·6 —0·8
Total proteins	...	2·8 —3·2
Total reducing sugars expressed as maltose	...	65 —75

Malt extract contains maltose together with other constituents like dextrin, dextrose and small amounts of other carbohydrates. Of the reducing sugars present, maltose should naturally constitute the major proportion. The estimation of these individual reducing substances is not possible by the ordinary volumetric method of Lane and Eynon. The separation and estimation of maltose and dextrose can, however, be effected by the paper chromatographic technique. A biochemical method (4) also has recently been reported for the accurate estimation of maltose and dextrins in malt extract. These methods are not, however, quite suitable for routine control of the quality of the product at the factory. They will, however, be useful as indicators of any adulteration of malt extract with glucose syrup, etc. The estimation of ash and phosphoric acid also will be of additional value in detecting any adulteration of the product.

The quality control does not stop with the production at the factory alone. It extends to other fields such as packing, storage and distribution, which are incidental to the marketing of the finished product. Malt extract is generally reinforced with vitamins A and D, derived mostly from fish liver oils. The blending of these liver oils of high potency requires careful technical as well as analytical control. Stirring is to be conducted in an inert atmosphere to reduce losses in the vitamins. The oils as well as blended extracts should be analysed for their vitamin content to see that they are upto the standard. The final product should be packed preferably in amber coloured bottles to minimise losses of vitamin A during storage and distribution. Care should also be taken to ensure that there will be neither leakage nor spoilage of the product in the bottles. The bottles should be stored in a cool and dry place to avoid frothing of the extract and occasional bursting of the bottles. The success of the industry will depend to a large extent on the care which is taken to control the quality of the product at every stage the of process, right from the field down to the consumer.

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BOOK REVIEW

Genetics

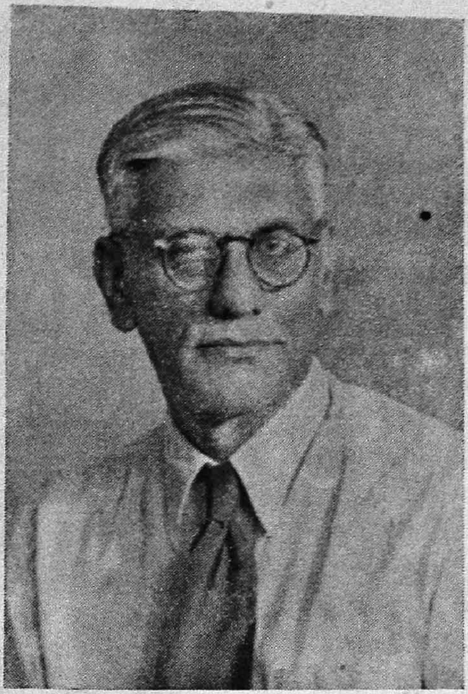
Professor Darlington's book starts with an amusing history of the science of heredity, from the Bible to Darlington, with excursions to telegony, the Kammerer case, and Lysenko. It builds up a WELTANCHAUUNG explaining the riddles of the universe in terms of chromosome and genes, and ends with a new gospel designed to cure scientifically the evils of our time. Thus, problems old and new — cancer, evolution, language, criminality, race, the classes in human society, divorce and homo-sexuality, Freud, the belief in immortality, the rise and fall of civilization, and the indeterminacy principle — are solved by saying that it is all due to the genes. The principle that what is genetically determined is rather a normal of reaction than manifest characters seems to be by-passed in a rather cavalier fashion.

Professor Darlington is, however, highly successful in giving us a mythology of the gene, where those little nucleic acid dots play a role similar to that of fairies, furies, and gods in the times of old.

[Extracted from 'Book Reviews' - *Endeavour* - Vol. XII. No. 51, July 1954.]

(N. K. I.)

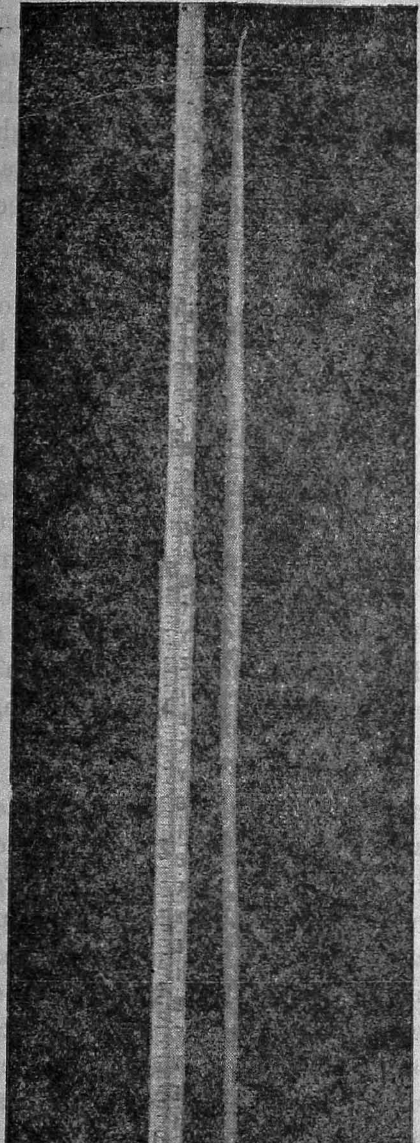
OUR NEW PATRON



SRI M. R. BALAKRISHNAN, B. A., B. SC. (Ag.)

We are proud to welcome as our new patron Sri M. R. Balakrishnan, who was lately the Government Agricultural Chemist incharge and Lecturer in Chemistry at the Agricultural College and Research Institute, Coimbatore. He is the son of the late Rao Bahadur M. R. Ramaswamy Sivan, Retired Principal of the Agricultural College and an eminent scientist of this State. Like father like son Sri M. R. Balakrishnan was a popular officer and an able scientist and has seen service in many fields ranging from the Tungabhadra soil survey to the F. A. O. Soil Training Course held at Coimbatore. He is well known for his extra-curricular activities and was ever a prominent figure both in the athletic field and the stage. He has retired from Government service and has been pleased to honour the Madras Agricultural Students' Union by becoming its patron. We wish that all the eminent officers of the Agricultural Department would follow his example in becoming our patron and thus show their lively interest in the promotion of the art and spread of Agriculture through their support to the Madras Agricultural Journal, which is a premier organ of this State devoted to the advancement of Agriculture.

Nine Foot Long Snake Gourd (*Trichosanthes Anguina* Linn)



The fruits of *Trichosanthes anguina* popularly called the snake gourd are generally long, varying from about one foot to five feet. The present case recorded in this note, showed a length of 9 feet 1 inch, (vide figure) which appears to be an exceptional one. The fruit was slender and weighed 2 lb. 10 oz. This was grown in the kitchen garden of Sri Mangalam Pillai at Coimbatore with out any special attention. The vine has so far produced five fruits and as the first three fruits had grown over eight feet and had touched the ground, the vine had to be lifted up with the help of ropes.

It may be of interest in this connection to note that a special type of ribbed gourd (Luffa acutangularis) called "yard long ribbed gourd" is under trial at some of the Agricultural Research Stations of our state. A few years back the author had seen a bitter gourd (*Momordica charantia*) which had attained nearly 12 to 15 inches. Since correct information and data on these common South Indian Vegetables are not available, it is thought to be worthwhile to have records of these made; further this will give an inducement for the growing of vegetables with personal interest in kitchen gardens.

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D. DANIEL SUNDARARAJ.

Botanical Gardens and Parks in Relation to Vanamahotsav

After the depredations on our forests during the second world war, which brought in its wake the failure of the monsoons and the appearance of a terrible famine, it was brought forcibly to all thinking people that there should be an all-out effort to grow trees in abundance all over the country and in all possible places to prevent the recurrence of drought and famine. It was therefore that Vanamahotsav was started as an annual feature four years ago, though the art and value of growing trees in general for the welfare of the country, has long been known to us.

Vanamahotsav work requires technical skill, a planned organisation and a sincere execution. This work should be entrusted to botanists in charge of botanical gardens, parks and arboretum.

At present there is at Madras the Agri-horticultural gardens at Teynampet, another at Coimbatore attached to the Agricultural College and Research Institute, a third and one of the most valuable and pretty gardens at Ootacamund and a fourth at Coonoor which goes by the name of Sim's Park. These gardens must be expanded and in addition to their being places of botanical research on fundamental work, they should as well serve for plant introduction and acclimatization trials and what is more important as centres for propagation and distribution of seedlings for Vanamahotsav.

In order to make people tree minded there should be a display of important hardy trees in parks which should be fast multiplied and strewn over the entire state in cities as well as in large villages. In this connection, it is interesting to note that there is a grand plan for Botanical Gardens for tropical countries. It is understood that the International Botanical Congress has recognized India's contribution in the field of botanical research by giving her a place in the Tropical Section of the First International Association of the Botanical Gardens that came into being at the Paris Session of the Congress this year. Among the two Asians elected to this body, it is a matter of pride to note that Prof. K. N. Kaul, Director of the National Botanical Gardens, Lucknow is one. It is but proper that the Indian Government have taken over Lucknow's National Botanical Gardens where an eminent botanist like Prof. Kaul is working with his band of researchers. The Madras State which can be legitimately proud of its state owned gardens, the rich herbarium, and her botanists can well link herself up with the Lucknow gardens and get plenty of material for her work. It is just possible that some exotics may prove very useful. As a matter of fact there are today amongst our very important economic plants a good many which have come from other countries and come to stay in Indian

soil and under our climatic conditions. For example, coffee, tea, rubber, Cinchona (quinine), potato, tobacco, chillies, tomato, sweet potato, cambodia cotton, sea island cotton, cabbage, carrot, apple, pear etc., are just a few that can be easily cited. Among the common useful trees which have come from outside India are to mention a few, Gold Mohur, *Peltophorum*, *Jacaranda*, *Gliricidia*, *Grevillea*, the wattles, the *Eucalyptus*, etc. In a country mainly agricultural such as ours, everybody could take up the Vanamahotsav work as a piece of social service and help the country to get enriched in its tree flora to gather the rains, give shade and yield a good many economic product.

S. N. CHANDRASEKHARAN,
Government Lecturing & Systematic Botanist
and
Vice-Principal, Agricultural College &
Research Institute, Coimbatore (Retd.)

R. S. Puram P. O.,
Coimbatore,
14th Nov. 1954.

NEWS AND NOTES

The Agricultural College Students participated in the Intercollegiate oratorical competition held under the auspices of the Red Cross Society, on 4th November 1954 in their premises. The College was represented by Mr. William Odongo Ommamo of class iii and Mr. S. Ramachandram also of class iii. Mr. Odongo knocked off the first prize and Mr. Ramachandran was awarded a special prize.

The Students gave a farewell party to Mr. Sankaranarayana Reddy, the the retiring Vice-President of the Students' Club on 12th November 1954 on the eve of his transfer as Asst. Engineer, Soil Conservation. On the same day Dr. A. Mariakulandai was elected as the new Vice-President of the Students' Club.

Sri Sundram Subramaniam of Class III won the merit award in the Intercollegiate S. P. C. A. Essay Competition held under the auspices of S. P. C. A., Coimbatore, on "What functions do you expect the S. P. C. A. to undertake in a welfare society".

Prof. H. Enoch, Zoology Professor from the Presidency College, Madras addressed the Students on "Heridity and Evolution" on 19—11—1954 under the auspices of the Students' Club. Sri S. Kannan was the Student President for the lecture.

GLEANINGS

Plant Hormones, an extract of the Fernhurst Lecture by S. C. Harland, Jour. of the Royal Hort. Soc. 78, 157, 1954: The term "hormone" was minted in 1902 by BAYLIS and STARLING, and it is derived from a Greek word meaning "I arouse to activity." Hormones denote chemical substances secreted by the endocrine glands which, when carried by the blood stream to another organ, affect the functioning or activity of that organ.

Hormones are also called "chemical messengers." All animals possess certain tissues and organs performing different functions, and special activities. The entire body has to work as an integrated and harmonious entity. No one part or tissue has to get out of step. Organs and tissues must therefore in some way be subject to a system of co-ordinating controls. These controls are, so far as animals are concerned, of two kinds. There is first the nervous system, which "may be likened to an intercommunicating network of telegraph wires centering in the brain, spinal cord and ganglia." Second there is a complex system of hormones or chemical messengers emanating from the endocrine glands which by altering the activity of an organ, also affect the activity of others. Adrenaline, or epinephrine, is an animal hormone secreted by the adrenal glands. In periods of stress brought on by fear, rage or hunger, there is a discharge into the blood-stream of a much larger amount of this substance than usual. There is a rise in blood pressure and a general mobilization of bodily forces which enable the organisms to meet the emergency.

Another animal hormone is insulin, which is secreted by the pancreas and has to do with sugar metabolism and with the control of the blood sugar level. Failure of insulin production brings about the disease known as diabetes, and the therapeutic use of insulin for this disease is now well known.

A plant is also an association of different tissues and organs which require the same kind of co-ordination as we have seen to be necessary in animals. Plants have no nervous system and any co-ordination must therefore be through other mechanisms. It can be shown that there are in plants chemical substances which are formed in one part of the plant; they pass to other parts; they produce special growth effects, and they are thus entitled to be known as plant hormones.

Hormones and Root Growth: An example of hormonal regulation in a plant is provided by the relationship between roots and leaves. By means of special techniques it is possible to grow excised roots in an aseptic culture medium. If this medium contains the right substances in the right amounts, these isolated roots grow as fairly normal roots. The medium first employed was one containing a complete array of mineral salts, with added sucrose, to supply the carbohydrate normally transported from the leaves to the roots. In successive transfers of flax roots to fresh media it was found that growth became poorer with each successive transfer. The roots needed something for growth which they were either not getting at all or which they were making in too small an amount. The necessary substance proved to be the well-known vitamin thiamine, and it was needed in the very low concentration of one part to ten million. When supplied the roots grew well.

The nutritional requirements of Tomato roots are somewhat different, and vary somewhat from strain to strain. Some strains need not only thiamine, but also pyridoxine, nicotinic acid, or both these substances.

How does the root obtain its supply of thiamine and other necessary substances? It can be shown by some simple ringing experiments that in the

Tomato plant thiamine accumulates above a stem girdle between the root and the stem, and also above rings at the base of the leaves.

Thiamine is therefore a factor influencing cell division. It is also a factor influencing respiration. Pyridoxine is concerned with the synthesis of amino acids; nicotinic acid has to do with respiratory enzymes. All three substances thus play an essential part in the biochemical economy of the plant.

Leaf Growth Hormones: The amino acid adenine functions as a leaf growth hormone in the pea plant. When tried with leaves of certain cereals, however, it was without effect. It is therefore likely that different species of plants need quite different substances to play the role of leaf growth hormones.

Stem Growth Hormones: These comprise a series of hormones which are synthesized in the apical bud or young extended leaves and then transported to the elongating parts of the stem. If you take a section from the growing region of a pea plant which has been kept in the dark, and place it in a nutrient solution containing mineral salts and sugar, there is practically no growth. But if a small amount of the substance IAA (indoleacetic acid) is added, there occurs a very rapid elongation of the excised section.

This substance, IAA, is therefore proved to be instrumental in speeding up the growth of stem tissue. It works also in very low concentration, since only about ten parts per million are required to bring about the effect. Growth substances such as IAA and related compounds are known as auxins. Auxins are concerned not only with stem elongation but also with other growth co-ordinating processes within the plant.

More instances of Hormone Effects: It is now possible to grow the excised ovaries of Tomato in a culture medium. The tiny ovaries are excised shortly after pollination and placed in a medium supplemented by the juice of either green or red tomatoes. This juice presumably contains substances necessary for growth which are probably transported to the ovary from other sites, but neither the sites nor the chemical nature of the substances are known. Lately it has been discovered that the substance NOA (naphthoxyacetic acid) acts as an adequate substitute for tomato juice. The cultivation of fruits in artificial media obviously has exciting possibilities for the future.

Nutritional Needs of Plant Embroys: Minute and only partly developed embroys can be caused to develop by using an artificial culture medium supplemented by additional substances in low concentration. These include some vitamins of the B complex such as thiamine and pantothenic acid. Other unidentified compounds are known to be contained in yeast extract, malt extract, and coconut milk. The growth of mature embroys can be speeded up by addition to the medium of thiamine, biotin, nicotinic acid, and other special substances.

Wound Hormones: Wound-produced substances may also be counted among the plant hormones. If a Potato tuber is cut, the surface soon becomes covered by a layer of corky cells, but if the injured surface is washed just after cutting, the layer of healing cells is not formed. One wound hormone has been isolated from injured Bean pods. It is known as traumatic acid. It is not effective with tissues other than those of the Bean and it seems likely that different species of plants are characterized by wound hormones of chemically diverse types.

List of Plant Hormones: *Indoleacetic acid.* The hormonal function of IAA (indoleacetic acid) was first discovered in 1934 It was the first naturally occurring hormone to be identified, although MAJIMA and HOSHINO of Japan had synthesized it as early as 1925.

In 1935 ZIMMERMAN and WILCOXON announced the discovery of other organic synthetic substances with hormonal properties. The most important of these were: NAA (naphthalene acetic acid); and IBA (indolebutyric acid).

In 1938 LEVINE established that another substance behaves as a hormone: NOA (naphthoxyacetic acid).

In 1942 ZIMMERMAN and HITCHCOCK reported on the effects of yet another synthetic compound on plant growth: 2, 4-D (2, 4-dichlorophenoxyacetic acid).

In 1943 ZIMMERMAN found that 2, 4-D induced hormonal responses in plants. These four synthetic hormones, all discovered within a period of eight years all produce hormonal responses, but to different degrees.

The list of synthetic substances with growth regulating properties which can be used in agriculture and horticulture is now very large.

It will be of interest to enumerate some of the things which plant hormones can do, and for which they are used at the present time.

1. Weed control.
2. Cause flowers to remain on a tree.
3. Cause flowers to drop off.
4. Produce fruits without pollination.
5. Prevent the formation of fruit.
6. Cause more fruits to develop.
7. Cause total or partial elimination of fruits.
8. Produce earlier fruits.
9. Produce later fruits.
10. Produce seedless fruits.
11. Produce fruits with more seeds.
12. Induce root formation (on cuttings).
13. Prevent the sprouting of tubers (Potato).
14. Cause defoliation.
15. Enable difficult plant hybrids to be made.

This list is a formidable one, and it will be readily seen that these practices do represent an enormous advance in agricultural techniques and that we are veritably in the middle of an agricultural revolution.

1. *Weed control:* It will have been noted that the discovery of the hormonal properties of the substance 2, 4-D took place in 1942.

2. *Prevention of pre-harvest drop of fruit:* The second largest outlet for the use of plant hormones is for the prevention of pre-harvest drop in fruit. The weed-killing substance 2, 4-D has also been used for this purpose, and also for accelerating the ripening of green bananas and apples. There are now many proprietary products on the market, but chemically they all appear to be naphthalene acetic acid (NAA) or a new substance, 2, 4, 5-trichlorophenoxy-propionic acid.

NAA is applied as a spray at a concentration of ten parts per million or as a dust at 0·1 per cent. The time of application is just as soon as much dropping becomes evident. The substance 2, 4, 5-trichlorophenoxypropionic acid (2, 4, 5-TP) is effective in controlling fruit drop and is also said to improve colour. Varietal differences affect the efficiency of the particular chemical substance used. NAA does not work very well with some varieties whereas 2, 4-D has been a success.

3. *Elimination of excess fruit:* The problem of how to deal with too much fruit in Apples and other fruits has also been the subject of experiment. Hand thinning is of course an expensive operation. Here the same substance NAA is used at low concentration, and is applied at the flowering stage or shortly after.

4. *Hormones in horticulture:* (a) Prolonging the blooming period. The use of hormones in horticulture is now widespread for a great variety of purposes. They will prolong the flowering period of such trees as the flowering Cherry (*Prunus spp.*).

The spray should be applied when most of the flowers are fully open.

(b) Preventing fruit production in flowering trees. Several compounds are used, depending on the species involved. NAA works with some species (*e. g.* Horse Chestnut) but now with others (some types of purple Crab Apple).

A compound so far not mentioned, maleic hydrazide was found to prevent the fruiting of the Maidenhair tree (*Ginkgo biloba*).

(c) Rooting of cuttings It is common knowledge that some plants can be grown very easily from cuttings and others not at all. Hormones can be used to hasten rooting. There are many synthetic products in commercial use and these are mainly IBA (indolebutyric acid) and NAA (naphthaleneacetic acid) together with related compounds.

(d) Producing fruits without pollination. A hormone spray will induce abundant setting of fruit, not only in Holly, but also in Tomatoes, Fuchsias, and many other plants.

Seedless tomatoes can now be produced to order by using a large range of compounds.

Indolebutyric acid is recommended, but there are now many others.

(e) Preventing Potato and stored nursery stock from sprouting. Hormone treatment can be used for inhibiting the growth of sprouts. A good method for the small gardner is to use a handful of confetti impregnated with hormone to each bag of potatoes. The hormone used is naphthaleneacetic acid in the form of its methyl ester.

The use of hormones for making difficult plant hybrids. Hybridization between varieties within a species is usually easy. Hybridization between different species in a genus is more difficult and depends very much on the genus and on the species. Some species crosses are easy and others difficult or impossible.

One frequent cause of lack of success is the fact that even if one or two seeds do result from the application of pollen from a different species, the fruits drop off or do not mature. Or the pollen tubes grow so slowly that the flower drops off before fertilization is effected. Many new hybrids, formerly considered to be impossible have now been made with the aid of plant hormones. [A. M. K.]

Press Mud Manure for Sugarcane: Press mud or press cake is a bye-product of the sugar industry and under good working conditions the amount of this bye-product produced comes to between 1·25 percent to 1·75 percent of canes crushed. The analysis of press mud is given below:

Moisture 9·48, Phosphoric acid (P_2O_5) 5·98, Nitrogen (N) 2·03, Potash (K_2O) 0·26, Lime (Ca) 1·96.

Press mud is best dispensed by the sugar factory to the growers if and when they desire such supplies, as it is best to return to the land as much as possible of the material, which the crop takes off from the land to keep up the fertility of the soil.

Plots receiving a basal dressing of ten tons of press mud per acre gave an average increased yield of 18·44 percent of canes per acre over the plots receiving no basal dressing. The basal dressing of press mud was applied in addition to the usual top dressing of concentrates. (Madras Agricultural Newsletter, October 1954.

[A. M. K.]

CROP AND TRADE REPORT

Crop Statistics, 1953—'54 Madras State, Cotton-Additional: The area under cotton in the Madras State in 1953—'54 is estimated at 8,48,500 acres. Compared with the finally recorded area of 7,27,500 acres for the previous year and an average area of 7,64,000 acres calculated for the five years ending with 1952—'53, this is an increase of 16 6 per cent and 11·1 per cent respectively. The increase in area is generally due to better seasonal conditions in the year. An increase in area is estimated in all the districts of the State except in South Kanara where the area estimated is the same as that of the last year. The area under cotton in the Nilgiris district is little or negligible. The main or first picking of cotton was over in all the districts. The crop was affected by unfavourable weather a conditions during the growing period of the crop in Tirunelveli district and by insect pest in Coimbatore and Malabar districts. The yield per acre was estimated to be higher than that of last year. The seasonal factor for the State as a whole works out to 91 per cent of the normal as against 90 per cent for the previous year. On this basis, the total yield works out to 2,62,400 bales of 392 lb. lint including yield from Kar pickings as against 2,13,200 bales of 392 lb. lint for the previous year and an average yield of 2,56,500 bales for the five years ending with 1952—'53, representing an increase of 23 1 per cent and 2 3 per cent respectively. The area under Kar crop in the State was estimated at 85,700 acres. The yield from Kar or Second pickings is estimated at 16,400 bales of 392 lb. lint.

The estimated area and yield of cotton by varieties in the current year together with the corresponding figures for the previous year are given below:

Variety		Area in '00' acres		Yield in '00' bales of 392 lb. lint	
		1953—'54	1952—'53	1953—'54	1959—'53
(1)		(2)	(3)	(4)	(5)
Madras American (Cambodia):					
Irrigated	..	1,007	753	679	492
Unirrigated	..	1,198	920	303	233
Madras American (Cambodia-Uganda):					
Irrigated	..	421	266	287	173
Unirrigated	..	544	346	140	87
Total Cambodia	..	3,170	2,285	1,409	985
Uppam in Central Districts	..	43	32	7	5
Nadam and Bourban	..	19	—	*	—
Total Salem	..	62	32	7	5
Tirunelvelies (a)	..	1,825	1,664	431	401
Karunganni	..	3,428	3,294	777	741
Total	..	5,253	4,958	1,208	1,142
Grand Total	..	8,485	7,275	2,624	2,132

* Less than 50 bales.

(a) Includes Uppam and mixed country cotton grown in the South.

The wholesale price of cotton lint per standard maund of 82-2/7 lb. or 3,200 tolas as reported from important market centres on 18—9—1954 was Rs. 94—3—0 for Coimbatore Cambodia, Rs. 86—4—0 for Coimbatore Karunganni, and Rs. 88—14—0 for Erode Cambodia. Compared with the prices which prevailed during the corresponding period of the previous year, these prices reveal a decrease of 4·2 per cent in the case of Coimbatore Cambodia, and 2·8 per cent in the case of Coimbatore Karunganni.

Cotton-First Forecast 1954—'55 : The area sown with cotton in the Madras State upto the 25th July 1954 is estimated at 71,000 acres. Compared with the area of 62,500 acres estimated for the corresponding period of previous year and an average area of 54,000 acres calculated for the previous five years ending with 1953—'54, this is an increase of 13·6 per cent and 31·5 per cent respectively. The increase in area is attributed to favourable seasonal conditions at the time of sowings. The area estimated is the same as that of last year in the districts of Chingleput, North Arcot, Tiruchirapalli, Tanjore, Madurai, Malabar and South Kanara and an increase in area is estimated in the other districts of the State except the Nilgiris. The area under the crop in the Nilgiris district is little or negligible. The estimated area by varieties in the current year together with the corresponding figures for the previous year is given below :

Variety	Area in '00' acres	
	1954—'55	1953—'54
(1)	(2)	(3)
Madras American (Cambodia) ..	238	210
Madras American (Cambodia-Uganda) ..	93	79
Total ..	331	289
Karunganni ..	229	195
Tinnevellies ..	138	129
Uppam ..	9	9
Nadam and Bourbon ..	3	3
Total ..	710	625

The average wholesale price of cotton lint per maund of 82-2/7 lb. or 3,200 tolas on 7—8—1954 was Rs. 92—9—0 for Coimbatore Cambodia, and Rs. 82—1—0 for Coimbatore Karunganni. Compared with the prices which prevailed on 8—8—1953 these prices reveal a decrease of 9·9 per cent in the case of Coimbatore Cambodia and 7·7 per cent in the case of Coimbatore Karunganni.

Weather Review — For the month of October, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	14·4	+ 2·4	34·7
	Tirurkuppam*	10·7	+ 3·4	32·8
	Vellore	6·7	— 0·1	26·7
	Gudiyatham*	8·5	+ 3·5	37·4
East Coast	Palur*	15·5	+ 8·5	39·8
	Tindivanam*	13·0	+ 6 8	39·8
	Cuddalore	18·4	+ 6·9	46·0
	Nagapattinam	16·4	+ 5 8	32·0
	Aduturai*	13·9	+ 8 6	34·8
	Pattukottai*	15 6	+ 10 5	50·4
Central	Salem	10·5	+ 4·1	36·3
	Coimbatore (A. M. O.)*	8·7	+ 2·5	24·4
	Coimbatore	9·4	+ 3·1	27 0
	Tiruchirapalli	10·1	+ 3·8	34·4

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	7·2	— 0·2	35·9
	Pamban	10·5	+ 2·0	23·2
	Koilpatti*	9 9	+ 4·2	31·5
	Palayamcottai	7·5	+ 0·4	18·3
	Ambasamudram*	8·0	+ 1·6	28·5
West Coast	Trivandrum	13·9	+ 3·2	60·2
	Fort Cochin	7·9	— 5·5	104 8
	Kozhikode	8 9	— 2·2	142·3
	Pattambi*	10·0	+ 1·4	91·9
	Taliparamba*	6·8	— 1·1	156·2
	Wynaad*	14·9	+ 6·4	96 9
	Nileshwar*	5·5	+ 2·2	177·3
	Pilicode*	6 7	— 0 1	167·1
	Mangalore	5·3	— 2·0	147 7
	Kankanady*	4·4	— 2·3	148·9
Hills	Kodaikanal	8·5	— 1·7	50·5
	Coonoor*	11·6	+ 3·4	47·4
	Ootacamund*	9·4	+ 1 0	36·7
	Nanjanad*	7 9	— 1·2	56·2

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

A feeble low pressure area persisted over the east-central Bay of Bengal on 1—10—1954. This moved westwards and caused unsettled conditions in the west-central Bay on 3—10—1954, which persisted upto 9—10—1954 and became less marked. The south-west monsoon withdrew from the whole country except in South Peninsula on 8—10—1954. An easterly wave crossed the south-west Bay of Bengal on 9—10—1954 and a trough of low pressure appeared over the west-central Bay of Bengal, accentuating the seasonal trough on 14—10—1954, followed by a fresh easterly wave on 17—10—1954. In the meanwhile on 15—10—1954 a trough of low pressure developed off the Malabar coast, which persisted for five days and moved away westwards on 20—10—1954.

Unsettled conditions were observed in the south-east Bay of Bengal on 19—10—1954, which concentrated into a depression, centered near latitude 9°N and longitude 97°E on the very next day and crossed the coast near Cuddalore on the evening of 21—10—1954, causing widespread rains in Tamil Nad, with locally very heavy rainfall along the east coast. After crossing the coast the depression weakened to a trough of low which extended between South Kanara and South Coastal Andhradesa on 23—10—1954. The trough of low again concentrated into a depression off Gopalpur on 25—10—1954, while moving north-eastwards, and crossed the coast of East Pakistan after two days.

During this period another trough of low pressure developed off Malabar-South-Kanara coast on 21—10—1954 which persisted for four days and extended northwards on 24—10—1954.

The seasonal trough over the south Bay of Bengal re-established itself on 28—10—1954, accentuated by a new easterly wave from Andaman Sea. A well-marked trough of low pressure persisted on the last two days of the month in the south-west Bay of Bengal.

The note-worthy rainfalls and the zonal rainfall for the month are furnished hereunder :—

Note-worthy Rainfalls for the Month

Date	Name of Place	Rain-fall	Name of Zone	Av. rain-fall for July	Dep. from normal	Remarks
15/10/54	Trivandrum	3·3"	North	10·1	+ 2·3	Above normal
16/10/54	Pamban	2·7"				
18/10/54	Coimbatore	2·9"	East Coast	15·5	+ 7·9	Far above normal
20/10/54	Tiruthuraipundi	14·32"				
do.	Muthupet	5·20"	Central	9·7	+ 3·4	Above normal
21/10/54	Nagapattinam	3·5"				
do.	Cuddalore	8·0"	South	8·6	+ 1·6	do.
do.	Madras (Meenambakkam)	5·8"	West Coast	8·4	— 0·4	Just below normal
do.	Madras (Nungambakkam)	4·7"	Hills	9·4	+ 0·4	Just above normal
do.	Villupuram	7·90"				

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore.

C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATIONS

Gazetted Service — Postings and Transfers

Name and Present Post	Posted as
Abdul Samad, Supdt. A. R. S. Palur,	Asst. Paddy Specialist, Pattambi.
Bettai Gowder, Asst. Fruits, Coonoor,	Asst. Fruit Specialist, Coimbatore.
Menon, R. G., Asst. Agrl. Eng. (Research), Coimbatore,	Agrl. Eng. Indian Institute of Sugarcane Research, Bhadruk.
Nagaraja Rao, P. R., Asst. in Ento.,	Asst. Entomologist, Coimbatore.
Sahadevan P. C., Asst. Paddy Specialist, Pattambi,	Asst. in Paddy, Pattambi.
Sundaram, S., Agronomist, Satyamangalam,	Officer on Spl. Duty for Development of Coffee Industry.
Sankaranarayana Reddy, N., Estate Civil Eng. Agrl. College, Coimbatore.	Asst. Agrl. Eng. Soil Conservation.

Upper Subordinates — Postings and Transfers

Name and Present Post	Posted as
Anandam Pillai, S., A. D.. Thandigudi,	A. D. Melur.
Balasubramaniam, K. R., A. A. D., Velur,	S. D. A. Tanjore.
Bhaskaran Nambiar, K., Asst. in O. S., Pilicode,	Paddy Asst., Pattambi.
Chacko, C. I., P. A. to D. A. O., Tellicherry,	F. M., Thituvazhan Kunnu.
Ganesa Pillai, S., A. A. D., Ambasamudram,	Paddy Asst., Coimbatore.
Govindaswami, T. N., Spl. A. D., Cuddalore,	A. A. D., Chidambaram.
Hariharan, S. V., Spl. A. D. for Training, Aduthurai,	A. D., Ambasamudram.
Kolandavelu Naicker, A. D., Conjeevaram,	A. D., Tirumani Leprosy Sanatorium.
Kuruvilla, M. G., P. P A., Myco., Shoranur,	P. P. A., Mycology, Tellichery.
Lingannan, K., A. D., Tirumani,	A. D., Conjeevaram.
Mahimai Dass, V., A. D. Kollegal,	Marketing Asst., Trichy.
Mahadevan, S. K., A. D., Melur,	A. D., Thandigudi.
Purushothaman, P. S., A. A. D.,	A. D., Manganallur.
Pattabhiraman, R., A. A. D., Perundurai,	A. D., Thudyalur.
Padmanabhan, M. K., F. M., Thiruvazhankunnu,	P. P. A., Mycology, Shoranur.
Ranganathan, S., Marketing Asst.,	A. A. D., Valavanur.
Ramadass, A., Spl. A. D., Chidambaram,	A. A. D., Periapalayam.
Ramaswami, A., Spl. A. D., Gobi,	P. P. A., Ootacamund.
Raghavan Dass, Spl. A. D., Coimbatore,	Cotton Certification Inspector, Rajapalayam.
Srirangaswami, Spl. A. D., Erode,	Asst. in Cotton, Coimbatore.
Thejamurthy, Marketing Asst., Tanjore,	A. A. D., Walajah.
Thomas, N. K., Spl. A. D., Lalgudi Co-op. Stores,	P. A. to D. A. O., Tellichery.
Venugopal, P. R., Spl. A. D., Chidambaram,	Spl. A. D., Cotton, Coimbatore.

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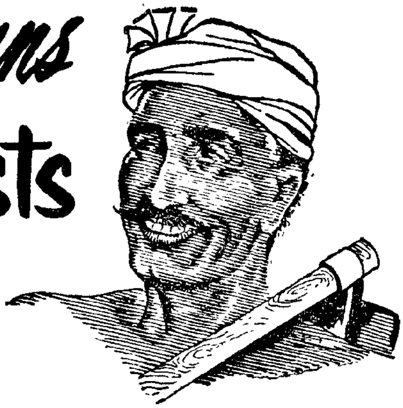

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The Madras Agricultural Journal

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Editorial

A Silver Jubilee: The Indian Council of Agricultural Research founded in 1929 on the recommendation of the Royal Commission in Agriculture has completed its twenty five years of useful work. The completion was marked by the celebration of the Silver Jubilee on the fourteenth of this month. We convey our hearty greetings on this momentous occasion.

Agricultural Research in India and in Madras is many years old. Dating back to 1871 when a small beginning was made at Saidapet, research in Agriculture had progressed to a considerable extent in the country. By 1928 a need came to be felt for coordination and organisation of the many research programmes that were being carried out in the different Research Institutions of the country. It was also felt that such coordination could increase the usefulness of the research and decrease its cost, which is very necessary in a country like ours where resources for research have largely to depend on Government munificience. In countries like the United States and England, research is backed not only by Government bodies as is the feature in this country but is predominently the concern of many enlightened firms, who subsidize research at Universities and Research Centres. This way, the tax payers, support to research through the Government sponsored organisations, is not only augmented but is also highly enthused by the interest evinced by the leading business magnates of the country. Our country has yet to stimulate this sort of interest in our leading financiers.

However, inspite of the limited resources at its disposal the Indian Council of Agricultural Research has succeeded in bolstering up research in this country. Much more than its financial backing to research we would put down as its greatest achievement the much needed planned outlook, which it has brought to bear on problems of research and its progress in this country.

We are proud of this occasion and proud to associate ourselves with this celebration of the Indian Council of Agricultural Research Silver Jubilee, as we in our own humble way have helped and contributed in the dissemination of the fruits of this planned research to our farmers through our pages.

Change of Office-Bearers: Consequent on the transfer of Sri. F. L. Daniel as Compost Development Officer, the Managing Committee has co-opted Sri. P. Madhava Menon, Assistant in Millets as Secretary and Sri. J. Sakharama Rao, Assistant in Botany as Treasurer vice Sri. M. V. Jayaraman proceeding on leave.

Marketing Supplement: We are glad to announce that from the next issue onwards the Madras Agricultural Journal will carry a Marketing Supplement which will contain matter specially contributed by the State Marketing Committees.

Our Cover: The picture on the cover page should be familiar to the old students of the Agricultural College. It shows the students of the College learning practical Agriculture. With a view to giving a new look to our journal, we propose to have different pictures in future on our cover page and in this we need the co-operation of our members. Photos blocks which may be of interest to our readers are invited for printing in our cover pages of the ensuing issues of the Madras Agricultural Journal.

Advances in Fertiliser Production and Use*

by

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Lecturer in Agriculture

One of the outstanding achievements in the field of Agriculture during the last one hundred years is the progress made in fertiliser production and use. Since the time Justus Von Liebig stressed the importance on plant nutrients and placed his patent manure on the market 110 years ago, scientists and manufacturers, the world over have probed into the problems of plant nutrition and nutrient supplies. Most famous are the studies at Rothamstead and Woburn in England, those of Wagner and Maercker in Germany, and those in the various states of the U. S. A. and in Pusa and Coimbatore in India. They have contributed a wealth of information on many phases of fertiliser production and fertiliser use in relation to soils and plant growth. This has resulted in the development of an industry of world-wide significance as an important branch of the chemical industry.

Early History: Even though the fertiliser industry occupies an important place today, until as late as 1940, fertiliser production was largely a byproduct subsidiary of the chemical industry. The era of cheap food prices till then, necessitated the sale of fertilisers at very cheap prices. Necessarily therefore, the fertiliser industry had to a substantial extent continue to be broadbased upon the by-products of other industries. The question then was whether any new process exclusively designed to produce a fertiliser suited to specific soil needs will ever hope to compete with the established byproducts of certain industries.

But with the departure of the cheap food era, the peculiar agricultural cum chemical background of the fertiliser industry is fast disappearing. Fertiliser consumption has expanded rapidly as can be found in the figures furnished in the subsequent paragraphs. A period of active technical development has now begun. Fertilisers are not just byproducts now, but have become largely specialised, and are produced and shaped to suit the needs of farmers in relation to their soil and the equipment used to apply them. Special methods of processing to facilitate easy application, the evolution of more specialised forms for increasing efficiency in

* Paper read at the College Day and Conference, 1954.

use, the production of better and cheaper types; are some of the lines on which the industry is bestowing more attention today.

Trends in Fertiliser Consumption: A review of the fertiliser situation during the last one hundred years would show that the industry did not make much progress in its early years of the twentieth century, farmers in some advanced countries had started using fertilisers in a small way. The American picture is quite revealing in this matter. As the largest consumer of fertilisers in the world today the United States of America reflect in a real manner the trends of fertiliser consumption. At the beginning of the century, the annual consumption of fertilisers there was only two million tons, while it is over twenty million tons today; a ten-fold increase. The British picture is more or less, quite similar. The real situation in regard to fertiliser consumption of other countries is rather misleading as disturbances of the war cut off their normal production and supplies. For instance, the high fertiliser consumption of several European countries dropped sevearly during the war years.

Looking at the Indian picture, we find that fertiliser consumption on any Substantial scale began only during the period of World War I. But rapid strides have been made in the development of the industry during the last decade. The war years witnessed a quick expansion in the consumption of fertilisers as also in their production. From a low of 30,000 tons during the thirties largely as a byproduct of the coke industry and the Belagula synthetic nitrogen factory in Mysore, ammonium sulphate production expanded more than ten times and very soon it is expected that production will touch half a million tons. Two new factories were set up, one in Alwaye, Travancore and another in Sindri. The first five year plan envisages a production of 4,60,000 tons of ammonium sulphate and 1,76,000 tons of superphosphate in addition to the 50,000 tons of bone meal produced in the country. Alongside of the increased production and consumption, we witness a marked change in the pattern of consumption of fertilisers. During the earlier years, the consumption was largely limited to the plantations and the hill crops like potatoes. This pattern has now changed and the largest consumer now possibly is the rice farmer. The price situation of agricultural commodities has done more to change the pattern of fertiliser consumption than anything that has happened during the last four thousand years.

The Supply Position: *Nitrogen:* Until World War I, the source of supply of this plant nutrient was partly ammonia, a byproduct from coke ovens, and partly nitrate from the South American nitrate deposits. These supplies were soon found inadequate, but by this time the fixation methods of atmospheric nitrogen had been perfected and between 1918 and 1930, the process was firmly established. Indeed by 1930, three quarters of the world's needs of fertiliser nitrogen were produced from the air. By 1939, Europe, where the fixation industry established itself first, was not only self supporting but was exporting large quantities to the outside world, with Germany as the largest producer. The United States of America was then largely an importer, but rapid strides were made during the forties in that country to make up the deficit. Many nitrogen fixing units were established during World War II mainly for the production of explosives but after the war was over, these were switched over to fertiliser production. The world production in 1950 of fixed nitrogen was to the tune of 2½ million tons.

Phosphorus: The main source of the world's fertiliser phosphorus is the various deposits of rock phosphate which are largely found in North America, United States of America, U. S. S. R., Dutch West Indies and Oceania. Some of these latter deposits were damaged during the war but are being rapidly rehabilitated. Annually about twenty million tons of rock phosphate are mined and utilised in the manufacture of various products, chief being the fertiliser superphosphate. Most of these flour-apatites are made available with sulphuric acid and until the time of World War II, the acid superphosphate process was a means of utilising the surplus sulphuric acid production which existed then in many countries of the world. There was therefore, considerable international competition in the disposal of this surplus acid which led to enormous price cuts in the superphosphate fertiliser scales. But this picture has now changed. What with the shortage of world sulphur supplies and the use of sulphuric acid in other more profitable directions, superphosphate today is selling at three to four times the prewar price.

The positition in this country in regard to phosphate supply is extremely difficult. Supplies of sulphur have to be largely imported. In regard to rock phosphate also the mineral has to be entirely imported. In India unfortunately, no supply of phosphate rocks has been within her terrain so far, barring the Tiruchirappalli nodules found in that district. These nodules have not been exploited to any extent and therefore an urgent need exists for

exploitation of this phosphate deposit. The application of finely powdered rock phosphate as such, in some of the acid soils is worthy of further experimentation as it is reported that this method is finding favour in the coconut and tea areas of the west coast, and also in Ceylon. It is for consideration, whether the nodules could not be processed into a fine form and made available for such direct application.

Other sources of phosphatic fertilisers in India are bone meal and a little of basic slag. The latter is confined to the very small and insignificant output from the iron industry. Bonemeal on the other hand is an important source and it has been estimated that the annual available supplies would amount to about 60,000 tons. A large portion of the bonemeal is however exported as the unit value of the phosphorus from bonemeal is relatively high compared to that from the mineral superphosphate and therefore the latter is a cheaper source of phosphorus.

Potassium: Potassium is another major plant nutrient essential to plant growth. Under the tropical climatic conditions obtaining in India however, the soils are subject to intense weathering, thus liberating adequate quantities of potassium which forms a substantial portion of the soil mineral matter. The soils in India are therefore generally well supplied with potash reserves, excepting possibly the laterites. Consequently, manurial experiments with nitrogen and phosphorous have not given significant results in crop production except possibly in the case of some special crops like tobacco, chillies, potatoes and groundnut. Potassium shortage may possibly arise only under intensive cropping conditions where the natural speed of weathering may not keep pace with the removal of potassium by the growing crops.

But elsewhere in the world, potassium plays an active part as an essential plant nutrient. Potassic fertiliser consumption trends indicate that its use has considerably expanded in recent times. From a low of 68,000 tons in 1880 the consumption touched a high of 28,80,000 tons by 1940 and to about for million tons by 1950. Upto the period of World War I, potash supplies were a German monopoly but the war experiences forced other countries to develop alternate sources. Today, potash deposits are extensively worked, not only in Germany but the United States, the U. S. S. R., France, Spain and Palestine. Large potash deposits are reported to have been located in Canada recently.

Analysis of consumption trends: Analysis of the figures of consumption of the three important plant nutrients give some interesting information in regard to the emphasis laid on one or the other nutrient in different countries.

Consumption of plant nutrients, 1950 :

Continent	in 1000 tons N	P_2O_5	K_2O	Ratio of plant nutrients N	P_2O_5	K_2O
Europe	1,641	2,367	2,380	1	1·44	1·45
North America	996	1,999	1,094	1	2·01	1·10
South America	65	75	21	1	1·15	0·32
Asia	567	320	139	1	0·56	0·25
Africa	117	149	34	1	1·27	0·29
Oceania	11	475	12	1	26·29	0·67
Total	3,405	5,386	3,681	1	1·58	1·08

The above figures of consumption are revealing in regard to the emphasis placed in the use of phosphatic fertilisers the world over excepting in the continent of Asia. In North America, the P_2O_5 application is more than double that of N and K. In Europe also, the extent of P_2O_5 use is greater than N. It is only in Asia that we find that the P_2O_5 application is less than that of N. In our country, we lay equal or sometimes more emphasis on Nitrogen than on P_2O_5. How far this tendency has to be modified the future alone could prove, but if world experience is a guide, the rate of application of P_2O_5 may have to be soon stepped up.

In the earlier sections, the trends of fertiliser consumption in various countries were given. But a proper comparison of fertiliser consumption can be made only by relating the consumption to the respective cultivated acreages. The following data from the Food and Agricultural Organisation relating to some countries of the world are interesting.

Consumption of fertilisers – (1946) :

	Lb. per acre of arable land N	P_2O_5	K_2O	Total nutrients
World average	2·9	4·5	2·4	9·8
Holland	56·0	92·0	90·0	238·0
Belgium	40·0	62·0	48·0	150·0

	Lb. per acre of arable land			
	N	P_2O_5	K_2O	Total nutrients
Germany	26·5	26·0	44·0	96·5
United Kingdom	9·0	31·0	13·5	53·5
Denmark	13·5	22·0	11·0	46·5
France	7·0	15·5	11·5	34·0
U. S. A.	2·5	5·0	2·6	10·1
Canada	0·6	1·4	1·0	3·0
U. S. S. R.	0·6	1·7	0·7	3·0
India (anthor's estimate)	1·0	0 3	0·1	1·4

It is seen that there is a high level of fertiliser consumption in some of the densely populated regions of Europe. Where the pressure of population on land is great, an intensive system of farming with high doses of fertiliser application have come to be evolved. This is possibly a lesson to India. Our agricultural output can be increased only by larger and larger applications of fertilisers.

Advance in fertiliser manufacture: It was mentioned earlier from a technological point of view, fertiliser production did not keep pace with the other segments of the chemical industry. Compared with the other processing industries such as synthetic rubber, rayon and plastics, fertiliser production was till recently woefully behind in the adoption of modern processes. Revolutionising developments are however now taking place in the industry.

Recent advances in fertiliser technology are directed towards (1) improving the availability of the various plant nutrients in relation to the soil conditions and plant growth, (2) in reducing costs of production, (3) in increasing nutrient concentrations to reduce handling costs, and (4) in evolving newer forms for better and efficient application. Some of these developments are considered below.

In the nitrogen field, developments have taken place largely in the use of new fertiliser materials like ammonia gas, ammoniacal liquids, urea and ammonium nitrate. Each has its own advantages and is suitable to certain favoured conditions. Recent interest has turned to the production of nitrogen materials of low water solubility. Outstanding development is the 'Urea-form' type of material which is now being extensively tested agronomically in America. Under controlled conditions, the reaction of urea with

formaldehyde gives a product which is quite slow in solubility and therefore would furnish nitrogen for plant growth at rate satisfactorily required during the growth of crop plants. It is well-known that the superiority of groundnut cake over ammonium sulphate is largely due to its slow availability, so that the nitrogen in the cake becomes available as and when the plants require the nitrogen. The 'urea-form' type functions in similar manner.

In the phosphate field, developments in the method of converting the phosphate rock into a form more available to plants than superphosphate by retarding or preventing the fixation of the phosphate in the soil are in progress. This is quite an important approach. It is well known that so far as phosphates are concerned the 'water soluble form' may not always be the easily available form when applied to the soil as the easy solubility may lead to the rapid fixation of the phosphate in the soil whieh may only be difficultly available later. This has led to a search for techniques by which acidification could be entirely eliminated and this has resulted in the evolutinn of the fusion processes. One such process is the high temperature fusion of the rock phosphate with silica resulting in the production of complex silica-phosphates. This type of phosphate is citrate soluble but not water soluble and field tests with this material in Great Britain have been found to be satisfactory. A factory was working there for a few months during the war in 1945 on this principle but was closed after the war. Work on these lines is in progress in Coimbatore. One handicap of the fusion product however, is reported to be its high alkaline reaction and therefore it is not mixable with ammonium sulphate in the manufacture of fertiliser mixtures. This is supposed to be of disadvantage in the fusion method in countries where fertilisers are largely applied in the form of mixtures. But in India, our farmers do not appear to have any such exclusive preferences in the matter and therefore as a fertiliser. This disadvantage may not be a great impediment in the use of silico-phosphate.

Another line of development in recent times is the improvement in the physical properties of fertiliser materials and also in their nutrient concentration with a view to reducing the bulk. This makes fertilser products more suitable for easy handling, storage and application. Secondly, such processing improvements like 'granulation' offer a chance of reducing the extent of phosphate fixation. This is possibly because, the application in a granular form exposes a lesser surface area per unit weight of fertiliser for soil contact than

the conventional powder form and therefore the chances of fixation are reduced. The efficiency of the phosphate application is increased thereby.

Developments in the production technique have arisen recently consequent on the shortage of essential raw materials employed in the manufacture of fertilisers. A classical example is the shortage of sulphur. This has resulted in new techniques in the manufacture of ammonium sulphate by the use of gypsum as is done in Sindri. Another consequential development arising out of this shortage is in the use of nitric acid in the treatment of phosphate rocks. The basic principle is in the acidulation of phosphate rock with nitric acid or nitric-phosphoric acid and the production of 'nitraphosphates' and this method is being widely advocated in the United States.

Advances in Fertiliser Application: Many advances have come about in recent times in the methods of application of fertilisers to increase their efficiency and also to economise in the quantities applied. This is due to the recognition of the fact that best method of fertiliser application is the one that would allow the crop to secure the nutrients in optimum quantities at the time required by the crop plants and at the places where they would be most effective. The placement of fertilisers near the root zone leads to greater utilisation of fertilisers. Further, smaller applications by placement have been found to produce the same results leading thereby to a greater efficiency and economy in the use of the fertiliser. For example, the application of ammonium sulphate by pelleting and placing the pellets in the reduction zone for paddy crop is reported to halve the requirement of the fertiliser to produce similar results within a certain range. The placement of phosphates is now an accepted practice in phosphate fertiliser application. Apart from reducing the chances of fixation, phosphate placement facilitates better uptake of this nutrient as phosphorous is largely immobile in the soil.

Other advances in application methods relate to the form in which various fertilisers are applied. For example, an important advance in nitrogen application has been the use of anhydrous and liquid ammonia in the direct form. This form carries 82 per cent N and therefore is becoming very popular in some countries for Horticultural crops. In the United States, it is reported that 15 per cent of the total nitrogen application in that country is in this direct form and its use is expanding. Considerable economy attends this form of application and therefore has a great future in India. Another

recent development is in the use of water solutions of ammonium nitrate. Spraying the leaves of fruit trees, specifically apple and citrus with a urea solution resulted in a much more rapid absorption of nitrogen than the conventional soil application. This method of spray application on the foliage is receiving much attention. Pre-treatment of seeds prior to sowing with phosphate solutions has been reported to result in larger crop yields.

Further knowledge in fertiliser behaviour under various conditions of soils and crops by the use of radioisotopes has been gained in recent times, and this bids fair to revolutionise fertiliser application methods or fertiliser use.

Conclusion: This is a changing world. Technogical changes in all fields both agriculture and industry have been breathtaking. When Malthus predicted that world population would out grow its food supply, the scientific aspects of agriculture were unknown. With our present knowledge of plant nutrient behaviour and use, we can falsify the dire Malthusian predicition. New and better bred varieties together with richer fertilisers now enable some farmers in our country to produce a 10,000 lb. paddy crop and a 100 tons sugarcane crop.

Acknowledgment: My thanks are due to Sri. P. A. Venkateswaran, Agronomist and Professor of Agriculture for his critical reading of the text and its revision.

Growing Calopogonium Mucunoides as a solution to Soil Erosion on the West Coast

by

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The increasingly devastating effects of uninterrupted soil erosion is perhaps nowhere more patent in this country than in the rolling topography of the South-West Coast of India exposed to an annual rainfall ranging from 100 to 200 inches. While expensive measures of soil conservation like contour bunding, bench terracing etc. are being formulated and carried out under National Plans as well as under the auspices of State Governments separately at very considerable cost, it may sound as fantastic to claim that soil erosion on the slopes of Western Ghats even with over 160 inches of rainfall need cause no concern and involve no expenditure exceeding Rs. 5/- per acre. That the above is neither a miracle nor an exageration would be clear from the following account.

When the Madras Government decided to locate the Central Pepper Research Station at Panniyur on the slopes of the Western Ghats, in Malabar District under the scheme financed jointly by the Madras Government and the Indian Council of Agricultural Research, they were confronted with the problem of conserving the soil on the site comprising gradients ranging up to one in three. Some idea of the extent of soil erosion that was likely in this site measuring 1150 feet from the summit to the foot of the slop and 1100 feet across the slope can be had from the fact that the mean gradient of the site is one in five, that the site is has loosely packed lateritie soil, that the locality enjoys an annual rainfall of over 160 inches and that the catchment area above the site is about 20 acres. The site, after clearence of the tree and scrub jungle growth and removing the stumps and roots and planting *Erythrina indica* standards for training pepper and further digging to remove the subsequent growth from remnants of the original vegetation by November 1952, could not but excite the doubts of almost every visitor as to how it would be possible to stem the rigours of the next monsoon on the newly cleared slopes with its innumerable pockets with sediments snd loose soil, ready to get washed down with the first torrential downpour. This was, in fact, the natural doubt expressed by some of the members of the Spices Enquiry Committee who inspected the site in January 1953.

The picture then and the picture of the site now present such great contrasts that they have to be seen before they can be believed. Some of the illustration (Figs. 1 to 5) in this article would perhaps help the reader to visualise the remarkable and almost astonishing changes that have been effected, all due to the remarkable crop, *Calopogonium mucunoides.*

This plant along with *Pueraria phaseoloides* (Tropical Kudzu) and *Centrosema pubescens* were no doubt well-known to planters to some extent, having been particularly fancied in rubber plantations. The trial of these cover crops on a small-scale in the Research Stations and Farms in Madras State was taken up under instructions from the present Director of Agriculture, Madras in 1947—'48. With the usual chequered career during the early stages of these small-scale trials at numerous centres, the special virtues of *Calopogonium mucunoides* as a cover crop for perennial plantations came to light at the Agricultural Research Station, Ambalavayal, Wynad during 1950, when it was grown over an area of about six acres in mandarian orange orchard. This success inspired the present author with the hope that in *Calopogonium mucunoides* lies the answer to the problem of soil erosion in the Pepper Research Station as well.

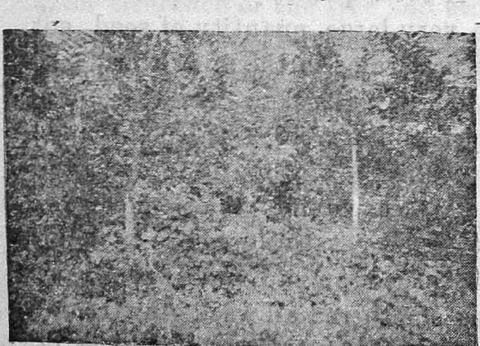
Accordingly with the receipt of light showers early in April 1953, a total quantity of 150 lb of *Calopogonium* seed was broadcast on the entire cleared area of 20 acres. In about three months, by the end of June 1953, when the south-west monsoon began with its usual heavy rains, *Calopogonium* had spread its matting vegetative growth so effectively over the ground, as to leave only the irregular rock outgrowths exposed to the view. The crop seeded profusely and dried up completely by January 1954 leaving a thick mulch of dry leaves over the entire ground. A total quantity of 800 lb of seed was collected, and in spite of this, a very large quantity of seed got dispersed on the ground. With the first rains in the middle of April 1954, the self-sown seeds germinated in profusion. As there was occasional rains in the months of April and May 1954, the plant made very vigorous growth and by the beginning of June 1954 when the south-west monsoon began with very heavy and almost incessant rains, the crop had produced a thick vegetative cover to over the entire gronnd. By the end of July 1954, the crop had made vegetative cover to athickness of nearly 12 inches, smothered all weed growth and covered even the rock outgrowths. The plant is found capable of growing to a length of about 8 feet in the course of about 16 weeks

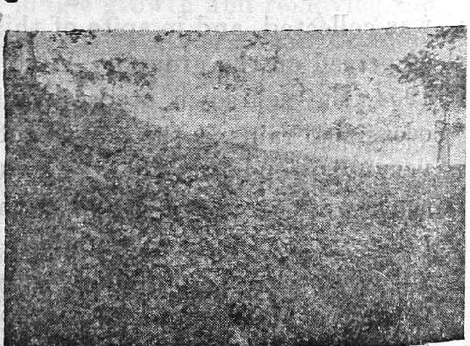
and to strike root at every one of the nearly 25 nodes over this length, though about 50% of these nodes only actually develop roots in the field. Each plant has three leader shoots and about eight main lateral shoots from each leader shoot. In addition to the large volume of leafy growth over the ground, the plants are found to have developed a large volume of roots in the ground.

1

2

3





In figure 1, a typical vegetative cover produced by *Calopogonium* within about four months of germinating is presented. The picture of a neighbouring private plantation without any cover and the bare ground exposed to soil erosion is presented in figure 2. The mass of leafy growth with fine roots produced from some of the three plants of *Calopogonium* in about four months is presented in figure 3. Thick shade as seen in figure 4 is not found to curb or limit the expanse of *Calopogonium*. Except when sheet rock with no soil whatsoever exists, the plant finds its way and establishes itself though the minutest cracks and crevices. As a means of destruction of weeds, it is patently effective and obviously cheaper than the most effective weedicide known. From figure 1 it will be seen that *Calopogonium* has practically smothered all weed growth including grass growth.

In figure 5, it can be seen how luxuriantly the plant has established itself on a steep embankment. The chief merit of *Calopogonium* as a cover crop, in addition to the ease with which it can be established in a very short period, is that it recedes to the back ground during the summer months, when it dries up, leaving the coast clear to the plantation crop to absorb all the moisture available in the soil. This is a great advantage and as important as the conservation of soil during the heavy beating rains of the South-West monsoon. The role of *Calopogonium* cover crop during summer is not limited to stepping aside for making all the soil moisture available to the plantation crop, as it also providee a protective dry mulch, an invaluable screen against the severe scorching sun in this period. thereby conserving soil moisture through considerably reduced evaporation of soil moisture. It has also another equally important function of enriching the soil by adding an amount of leaf-mould estimated at about 5000 lb. per acre annually.

Tropical Kudzu and *Centrosema* are no doubt valuable vegetative covers in their own way. But, *Calapogonium* has certain superior attributes such as drying up in summer and the ability to cover the ground within the shortest period. Profuse seeding is yet another virtue of *Calopogonium*. This results in the cover crop establishing itself every year with the summer showers from the self-sown seeds. From the foregoing, it will be seen that growing *Calopogonium* is the cheapest and most effective answer to soil erosion in plantations of pepper, orange and coconut on the West Coast, and will in addition act as an effective check against

obnoxious weed growth in these plantations, enrich the soil and conserve the soil moisture.

There are yet other uses for *Calopogonium* on the West Coast. The paddy lands of the West Coast depend primarily, at present, on green leaf collected from the forests and neighbouring vegetation as a source of organic manure. In fact, this together with cattle manure is the main manurial application that the large bulk of paddy area of the West Coast receives. The denudation of the forests as a result of cutting of trees for leaf and fuel has been a long-standing, vexing problem. The needs of the paddy grower as well as the safety of our forest wealth will be met or safeguarded if *Calopogonium* is broadcast on the extensive expanse of the grassy hillocks of the West Coast so that green leaf of this leguminous plant can be available for manuring the paddy fields. Extension of *Calopogonium* to the uncultivated grassy hill slopes is a desirable line of fostering food production at a minimum expenditure of money and energy, in addition to soil conservation on the hill slopes.

Acknowledgement: The author is very thankful to Dr. K. C. Naick, M. Sc., Ph. D. (Bristol), Headquarters Deputy Director of Agriculture (Research), Madras for his valuable help in the preparation of this paper.

Recent advances in Agriculture : Growth Regulators as Weed Killers *

by

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The aim of this paper is to give a comprehensive summary of the various aspects concerned with the use of growth regulators as weed killers.

Growth regulators used as weed killers: The derivatives of following three parent acids of growth regulators have been in vogue as herbicides :—

1. 2, 4 – dichlorophenoxy acetic acid.
2. 2 methyl – 4 – chlorophenoxy acetic acid.
3. 2, 4, 5 – trichlorophenoxy acetic acid.

In recent years, a few more hormone herbicides have been under trial, but are yet to come into as wide a use as the above.

Formulations used: These parent acids are used in the form of acids, salts, esters or amides, and they vary in volatility, solubility and availability. In the use of salts, sodium and ammonium salts are more widely in vogue as they are highly soluble in water. There is also some considerable difference of opinion with regard to the efficacy of these various formulations when used as herbicide. While Zimmerman and Hitchcock (1942) state that salts, esters, and amides are approximately equal in activity to the acid, Hamner *et al* (1947) make a general statement that esters are more effective than acids, and acids are more effective than salts. Taylor (1946) points out that 2, 4 - D acid caused greater inhibition than ammonium salt in certain plants. On the contrary, Ennis and Boyd (1946) after extensive spray treatments on a variety of broad leaved plants showed that the effectiveness of ammonium salt was in no way statistically different from 2, 4 - D acid.

Forms in which they are applied: These substances are applied for control of weeds in the form of sprays, dusts and aerosols. Very recently, the use of these chemicals in pellet forms has also come into practice. In order to make the sprays and dusts as active as possible and give a uniform coverage and distribution, the use of adjuants, wetting agents and carriers is resorted to. Usually

* Paper presented for the College Day and Conference 1954.

polyethylene glycols, like Carbowax 1500 is used as a wetting agent in aqueous sprays; and talc and powdered China clay as carriers for dusts. The preparation of solutions and dusts, and addition of wetting agents and carriers have all been elaborately described by Marth and Mitchell (1944), Carl *et al* (1948), Slade *et al* (1945) and Templeman and Right (1950).

Mode and time of application: Direct foliar applications as well as treatments of soil are being done. The treatments to soils may be made as a preplanting treatment (i. e. before sowing or planting in the soil), or as a pre-emergent treatment (after seeds are sown but before seedlings emerge) or a post-emergent treatment (after seedlings have emerged). Particularly in vegetables and legumes which are susceptible to the direct foliar applications of growth regulators, treatment of soils is resorted to. In all cereals in which the growth regulators can be applied as a direct foliar spray for control of weeds, it is safe to apply after the crops have tillered and upto the *early boot stage:* i. e. when the upper sheath is begining to swell with enlarging head.

Sensitivity of weeds to growth regulators and factors influencing their kill: Many aquatic weeds, broad leaved plants, woody shrubs and vines, and perennials are effectively killed or controlled by growth regulator type of weed killers. Hildebrand (1947). Hitchcock *et al* (1949 and 50), and Jackson (1951) and a host of others have stated that water hyacinth *(Eichornia crassipes)* and other aquatic weeds could be successfully killed by 2, 4-D and allied substances at concentrations raging from 1000 to 3000 parts per million. Destruction of dense woody shrubs, vines and trees by 2, 4-D and other similar substances have been demonstrated by Hamner and Tukey (1945), Tam (1947) and Thimman (1948). Concentrations ranging from 2000 to 10,000 parts per million have been used by them. Hitchcock and Zimmerman (1948), Mitchell and Marth (1948) Zimmerman (1953), and Hemphill (1953) state that many broad leaved plants can successfully be killed at concentrations ranging from 250 to 1000 parts per million. In general, a wide range of weed species are killed by hormone herbicides.

Although many weeds are susceptible to these substances, factors such as weed species, stage of growth, concentration of chemical used, temperature, rainfall etc. govern and influence their herbicidal toxicity. In general, all annuals are susceptible to 2, 4-D, when they are young and actively growing; and resistance increases

with advancing maturity. Perennials are most susceptible when treated at the bud or very early bloom stage, but are altogether less susceptible than the annuals. Temperature and rainfall are the two important factors affecting herbicidal property of these compounds. Tam (1947) reports that temperature ranging from 70° to 85°F through a large percentage of days are highly favourable for the action of 2, 4-D and other hormone herbicides. Marth and Davis (1945), Kelly. Sally (1949) have all shown that warm weather and higher temperature accelerate the herbicidal activity of 2, 4-D. Rainfall has an adverse effect on the herbicidal action value of 2, 4-D and allied substances, and Tam (1947), Thimman (1948), and Weaver et al (1946) have all shown that the rain following the application of 2, 4-D considerably decreases the herbicidal toxicity. As Avery (1947) points out, it is better for maximum effectiveness to apply these herbicides on sunny days in warm weather when weeds are young and actively growing, and rainfall is not expected within 24 hours of application.

General responses of crops to growth regulators: The successful use of growth regulators as herbicides in crops depends on the efficacy of these substances in killing weeds with least or no injury to crops. Crops however vary in their tolerance to growth regulators. In general, broad leaved plants are susceptible to them and members of the grass family are resistant to them. Although cereals in general are tolerant to these herbicides, variation in their responses is being reported. Templeman (1946), and Olson (1952) point out that barley is more liable to damage than either wheat or oat. Variation in the different varieties of the cereals like oat, corn, and sorghum had been observed by Dearbon *et al* (1948), Ellis and Bullard (1948), Derscheid *et al* (1953), and Gassaway *et al* (1952). Dunham (1951) in summarising the responses of plants to 2, 4-D brings out that the differential responses of plants to growth regulators may be attributed to the crop species, variety, dosage, time of application, stage of growth and environment. Mathews (1952) observing the tolerance of plants to growth regulators has classified them into three groups, viz. susceptible, moderately tolerant, and resistant. Legumes without waxy covering, brassicas, tomatoes, sugarbeets, onions, grapes, parsnips, and ornamental plants are generally classed as susceptible; potato, linseed and clover as moderately tolerant, and members of the grass family as resistant. Although vegetables and legumes are susceptible to direct foliar application of herbicides, good weed control without damage to them is possible with soil applications of hormone herbicides. In

fact, Alban and Keirns (1948), Warren (1948), Warren and Hernandez (1948), Havis and Sweet (1948). Danielson (1948), Lachman (1947) and many investigators have demonstrated the possibility of growing vegetables successfully in soils treated with growth regulators and at the same time controlling the weeds in those vegetable plots.

Residual effects on soils: The wide-spread application of hormone herbicides has created an important problem of the persistence of toxicity in soils. The toxicity of growth regulators persists in soils from a few days to several weeks or months depending on the soil condition and environmental factors. Brown and Mitchell (1948), Hernandez and Warren (1950), Jorgenson *et al* (1948), Akamine (1951) and many others have pointed out that factors like soil type, pH, soil moisture, addition of manure, autoclaving, temperature, rainfall and other environmental factors play a vital role in the dissipation of toxicity of these substances. Krishnamurthi and Srinivasan (1954) working on the nature of persistence of toxicity of 2, 4 - D under topical conditions report that sandy soils with a low pH, retain toxicity for a longer time than clayey soils with a high pH value, and have stressed the importance of pH, and soil type on the inactivation of 2, 4 - D toxicity when applied at herbicidal rates to soils. Although it is well known that the growth regulators are inactivated in soil after some time, the exact manner by which it takes place is not yet well understood. Micro-organisms are suggested as a primary factor for the dissipation of toxicity. The effect of growth regulators on micro-organisms, and *vice versa* have been studied to some extent. The action of growth regulators on micro-organisms is negligible but the effect of micro-organisms on growth regulators seems to be of paramount significance. Audus (1951, 52) has amply demonstrated that micro-organisms play a vital role in the dissipation of toxicity of growth regulators.

General progress in other countries with special reference to U. S. A.: Phenomenal progress has taken place in the western countries in the field of weed control by chemicals and the utilisation or hormone herbicides for elimination of weeds has become an established proctice. Particularly in U. S. A., there is a heavy demand for these hormone killers, and the 1951 figures reveal that 112 million pounds of phenoxy acetic acid derivatives alone have been consumed for weed killing purposes. There seems to be no crop or place in which they have not found use. They are used in field

crops, orchards, highways, aquatics and bushy forests. The following is somewhat the general dosage of 2, 4-D and allied substances in U. S. A. for weeding in certain important crops. It should be noted that the time and method of application vary with the crop.

Crop	Dosage employed (pounds per acre)
Corn	$\frac{1}{4}$ to $\frac{3}{4}$
Sugarcane	2
Wheat, oat & barley	$\frac{3}{4}$ to 2
Flax	1/8 to 1/3
Grasslands	$\frac{1}{4}$ to 3
Orchard Crops :	
(i) Apples, brambles etc.	$\frac{1}{2}$ to 2
(ii) Straw berries	2 to 3 (pre-planting treatment)
Vegetables, Legumes etc. :—	
(i) Asparagus, onion & bean	1 to 3 (pre-planting or pre-emergent)
(ii) Potatoes	$\frac{1}{4}$ to $\frac{3}{4}$
(iii) Peas	$\frac{1}{2}$
(iv) Clover	$\frac{3}{4}$
(v) Lucerne	$\frac{1}{2}$

Although U. S. A. has made great progress in this field and a vast amount of literature on this subject continues to be published in the States, it should be pointed out that some advances have been made elsewhere too. It can be claimed that Great Britain has all along been in the van of progress in the matter of weed control particularly in grass-land improvement, reclamation of marshland and in other directions with the help of these herbicides, but the utilisation of chemicals in cereals and orchards crop has been somewhat limited. In France, Australia, New Zealand, Italy, Peurto Rico, Hawaii and Japan, the use of these hormone weed killers and other chemical treatments for eradication of weeds has commenced. In Japan, Indonesia and Malaya, 2, 4-D and similar substances are used in rice fields for combating weeds.

In India the work in the field of herbicides is in its infant stage and apart from some preliminary and disconnected trials, very little has been attempted or achieved in an organised systematic

manner. Responses of some annual and aquatic weeds to hormone herbicides have been reported by Kar (1947), Padwick (1948), Thomas and Srinivasan (1949), Joshi *etal* (1950), Imperial Chemical Industries (1951) and Solomon and Rao (1950). Venkatarathnam (1950) has made some gross observations on the nature of responses of some South Indian crops to herbicides. Krishna Rao *etal* (1951) and Thakur (1952) have studied to some extent the effect of 2, 4-D and MCPA on nut grass. For the past two years, in the Department of Agriculture, Annamalai University, some systematic trials, particularly the effect of hormone herbicides on weeds, crops and soils under tropical conditions have been made and some of the results have been published as indicated elsewhere in the body of this paper, and others await publication.

Conclusion: Growth regulators are being widely used in some of the Western countries specially for control of weeds of several kinds viz. aquatic weeds, herbs, shrubs, trees and deep rooted perennials. The growth regulators used for herebicidal purposes, the formulations used, forms in which they are applied, mode and time of application, sensitivity of weeds to growth regulators and factors influencing their kill, general responses of crops to growth regulatiors, and residual effects on soil are all briefly described. The knowledge of behaviour of these substances on weeds, crops and soils is as yet incomplete, and the future work is bound to bridge the gap in our knowledge. However it can be said that one of the recent advances in agriculture is the use of growth regulating substances or plant hormones for herbicidal purposes.

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Media for Mass Cultures of the Ergot Fungus— *Claviceps Purpurea* (Fr.) Tul.

by

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Introduction: The cultures for mass inoculations with *Claviceps purpurea* (Fr.) Tul. are usually grown on sterilized rye grains in ordinary bottles (Hynes 1941; Thomas and Ramakrishnan, 1942). Similar procedure was adopted for the production of cultures on the Nilgiris. But shortage of rye grains during the last two seasons necessitated trials with other grains as media. Husked wheat, barley, oats, ragi and unhusked wheat were under trial. The results of these trials are recorded in this paper.

Materials and methods; The cultures were maintained in bottles. Half a pound of grain was used per bottle. An equivalent volume of water was added and the bottles were autoclaved under 20 pounds pressure for 45 minutes. The wheat used in these experiments was obtained from the Agricultural Researce Station, Siruguppa. Barley, ragi and oats were locally procured. The same isolate of the fungus was used to inoculate the bottles. After inoculation the bottles were kept on the laboratory bench for 2 months and then examined. Two bottles were used for each treatment. In another series 12 grams of jaggery were added to the grains before autoclaving,

Experimental: Periodical observations were made on the growths in the bottles. After the lapse of two months from the date of inoculation the contents of each bottle were stirred into 8 gallons of water and a uniform spore suspension was prepared which was subsequentaly used for spraying the rye crop in flowers. Drops of the above spore suspensions were examined under the microscopic field situated roughly at the centre of the mount under the high power objective. Counts from two mounts were taken in respect of each bottle.

Observations: In the case of husked samba wheat the medium became hard and sticky in consistency after autoclaving thus, making it difficult for the fungus to permeate the medium completely. For eye judgement the growth of the fungus was best in the case of rye, followed by wheat (husked), ragi, barely, wheat (unhusked) and oats in the descending order of merit. Growth was very sparse in the case

of unhusked wheat and oats. There were no observable differences in growth between the two treatments with and without jaggery. The data on the spore counts taken under the microscope in respect of the several treatments are presented in the table below:

Number of spores per field (roughly at the centre of the mount) under the high power objective (x40).

Date of inoculation: 28—8—1950. Date of examination: 28, 29 & 30—10—1950.

Treatment	Without jaggery Number of spores				Average	With jaggery Number of spores				Average
	I	II	III	IV		I	II	III	IV	
Rye	46	35	38	42	40	33	39	37	42	38
Wheat										
,, (husked)	31	26	24	33	29	26	31	27	21	26
,, (unhusked)	9	13	11	8	10	Not tried.				
Barly	10	14	16	11	13	Not tried.				
Oats	9	5	11	7	8	8	5	8	10	7
Ragi	20	14	23	19	19	16	21	23	19	20

Discussion: It will be seen from the table that none of the substitute media tried has proved equal to rye in respect of growth and sporulation. However, during times of need arising out paucity for rye grains, use of husked wheat and ragi grains can be resorted to as an emergency measure and the spore suspension may be prepared using proportionately less quantity of water so as to bring the spore concentration to the same level as in the case of rye media. i. e. about 40 spores per microscopic field under the high power objective, which is the normal concentration adopted for spray inoculation in the fields.

Summary and Conclusion: (1) Among several cereals tried as media for mass culturing of the ergot fungus, rye was found to be the best medium in respect of both growth and sporulation, followed by wheat (husked) ragi, barely, wheat (unhusked) and oats in the descending order of merit.

(2) Addition of jaggery does not induce better growth of sporulation.

(3) In the case of wheat, husking makes a lot of difference and increases sporulation nearly 3 times as compared to unhusked wheat. The effects of husking in the case of other cereals remains to be tested.

This paper was submitted to the First Scientific Workers' Conference held at Coimbatore in 1951 and was discussed in one of

he study group meetings held at the Agricultural College and Research Institute, Coimbatore. In the course of ths discussion Sri M. Sanyasi Raju, Government Agricultural Chemist suggested that malt refuse may also be tried as a medium for mass culturing the ergot fungus. It was replied that the above suggestion will be borne in mind if further studies were to be conducted.

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NEWS AND NOTES

In the Inter Collegiate Debating contest arranged by the Rotary Club at the Y. M. C. A. the Agricultural College was represented by William Odengo Omamo (III Year), Miss Sukenya Bai (III Year) and Mr. Govindarajulu (I Year). Mr. William Odengo Omamo tied for the first place with a Lady Student from Nirmala College.

The students brought out their terminal issue of the "Tatler" this month in an attractive get up with very many interesting articles and photos.

In the field of athletics, the College football team has come up to the finals in the Inter Collegiate tournament, having defeated the P. S. G. College of Technology in the semi-finals by one goal to nil.

The table tennis Intercollegiate tournament was won by the College having won in 5 out of 6 matches played in the tourney.

Research Note

Sowing Groundnut as Pods

In India groundnut is seldom sown as pods. The usual method of sowing is by dibbling well picked kernels behind country plough or drilling with indigenous implements. In America and Philippines groundnut is sometimes sown as pods to eliminate the tedious process of hand shelling. Sowing pods broken into bits, each containing one seed, is also in vogue in some countries but this is possible only with certain vatieties.

No experiment appears to have been conducted so far in India on sowing groundnut af pods. Iu the experimental Stations at Auburn, Alabama ond Georgia in the United States of America trials have shown that sowing of pods results in poor germination and stand resulting in low yields. Sowing groundnut as kernels is therefore recommended. An experiment was carried out at the Agricultural Research Station, Tindivanam to find out the disadvantages of sowing groundnut as podt.

Pods and kernels of TMV 2 (bunch) and TMV 1 (spreading) strains were sown during 1951—'52 rainfed, 1952 irrigated and 1952—'53 rainfed seasons in pots as well as in the field. In pots germination was observed on the fifth day in the case of bunch kernels and seventh day in the case of the spreading kernals. The pods germinated a day later in both the cases. Under field conditions the germination was delayed by one more day in the case of kernels and by two days in the case of pods. The percentage of germination was low in pods by 20 to 30 as compared with the kernels, the spreading variety recording a lower percentage than the bunch variety.

Kerle (1918) has recorded that germination of the kernels from the pods is not simultaneous and takes place one by one. Observations made on this aspect revealed that the "beak-end kernels," which develop later than the "stalk-end kernels," germinated first. Whereas in the bunch pods both the kernels germinate, in the case of the spreading variety the stalk end kernel germinates only in a few cases and even then it failed to grow as it was invariably found attacked by fungus. One hundred two seeded pods of both the bunch and spreading types were sown and tested for germination. It was found that only 69.5% of the kernels in the bunch and 54% of the kernels in the spreading variety grew into seedlings. If optimum moisture conditions were assured for more than ten days after sowing another 25% in case of bunch and 75% in case of spreading variety may sprout, to give double seedlings. The loss of valuable seed materials is the main defect in sowing groundnut as pods.

During 1952—'53 rainfed season, observation plots were laid out to study this problem in greater detail. Bunch and spreading types were sown adopting four treatments, viz., (1) as kernels, (2) as pods, (3) as pod bits — (This is reported to be in vogue in the U. S. A.) and (4) as pods with tip broken — this treatment was given to facilitate good germination. The results are presented in the following table.

Treatment	No. of days taken for germination	Germination percentage	No. of days taken from sowing to 1st flowering	Weight of pods in lb. required to sow an acre	Cost of seed including labour charge	Acre yield of pods in lb.	Percentage on control
TMV 2 (Bunch)							
Kernels	6	87	33	135	39	308	100·0
Pods	8	64	33	200	50	140	45·5
Pods bits	6	84	33	135	38	294	95·5
Pods with tip broken	8	70	38	200	58	227	73·7
TMV 1 (Spreading)							
Kernels	8	74	38	100	30	688	100·0
Pods	10	31	40	150	38	211	30·7
Pods bits	8	62	38	100	31	540	78·5
Pod with tip broken	9	36	40	150	41	201	29·2

The data reveal that germination is low and delayed when sown as pods. Flowering was also delayed by two to five days. Pods with broken tips and pod bits were inferior to kernels in all respects. The yields recorded show that even with increased seed rate (50% more in the case of pods) lower yields are obtained — 25 to 50% less in bunch and upto 70% in spreading type.

In conclusion sowing groundnut as pods results in delayed and poor germination and consequent low yields. The cost of additional seed material required is far more than the charges for hand shelling and picking good kernels. Therefore under conditions obtaining in Madras State, sowing groundnut as pods is not advantageous.

Kerle (1918) - Famer's Bulletin No. 119 - Department of Agriculture, New South Wales. 'Peanut - The unpredictable legume' - A symposium (Book published by the National Fertiliser Association, Washington, United States of America, 1951).

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ABSTRACTS

Insecticides : Derris is compared with other modern chemical insecticides like D. D. T., BHC, Lindane and Toxaphene. Derris is safer than any of these synthetic products. Cats and dogs can be safely treated with it since they are sensitive to D. D. T. etc. Flies though susceptible to D. D. T. and Lindane develop a resistance against these chemical insecticides in which case Derris and Pyrethrum can be used. Before the second world War, Derris—the natural insecticide was used per Helopeltis on Tea and Cocoa, Plutella maculipennis and Crocidolomia hinotalis on cabbage. This was replaced by D. D. T. during the post-war days. These insects having become resistant to D. D. T., Toxaphene, BHC or Derris are recommended for the former while Toxaphene, and Derris are for the latter. Derris when distributed in water and the mixture brushed on the skin of the affected cattle is able to control the warble fly (Hypoderma Spec) much better than any other synthetic insecticide. It has ovicidal action against Orgyia and controls the caterpillar pests of trees such as coliroa. Having residual action it prevents reinfestation of plants.

(Information and Research in 1953 of the Tropical products, Department of the Royal Tropical Institute, Amsterdam, Vol. 25. Page 69—1954) (A. L. D.)

BOOK REVIEW

Book on Weeds in Indian Agriculture by Thakkur : The book on "Weeds in Indian Agriculture" provides interesting reading. The author has attempted to describe some important weeds of Bihar, so that " other investigators of weeds may have something to begin with". The book is divided into two main parts; the first part of eight chapters deals in general with weeds and their control. The second part gives descriptions of a number of local weeds. There is a glossary at the end followed by ready reference to units of weight, capacity and area. A list of references is provided at the end

The author does not seem to be aware of the volume of work that has been carried out in India on weeds and their control. There is no reference either in the text or in the references cited in the end to the hand book of some South Indian weeds by C. Tadulingam and G. V. Narayana wherein, over 40 of the weeds described in the present work have been dealt with in detail. No mention is made of the work on the control of *Eichornia crassipes, Striga spp, Cyperus rotundus or Orobanche cernua* carried out in India by the use of selective weedicides or other methods. In the chapter on biological control of weeds it is stated in the 4th para on page 18 that the method is unknown in India. Evidently the author is not aware of the complete eradication of prickly pear brought about in South India by the introduction of the cochineal insect.

On page 109—110, *Polygala chinensis* is stated to occur in open scrub jungles and grassy grounds and yet deep ploughing and clean cultivation are suggested as control measures. It is presumed that these measures are not to be carried out in the jungles or the grassy grounds. Probably the author does not believe in the maintenance of natural vegetation over wastelands where they may be useful in preventing soil erosion and enriching the soil with organic matter.

Chromosome numbers have been given for several of the weeds but many others whose chromosome numbers are known at present have been left out. The value of the book is not enhanced by the inclusion of these chromosome numbers for some of the weeds.

The book needs thorough revision before it could be placed in the hands of the students.

T. S. R.

GLEANINGS

Compost your phosphatic fertilisers: (C. N. Acharya, Indian Farming IV, p. 9, 1954). Plants absorb phosphates in lesser quantities than they absorb nitrogen. Again, because most soils lack in organic matter and nitrogen greater stress islaid on nitrogen.

But there are areas like Eastern Madhya Predesh or South Bihar and the laterite zones as on the West Coast where the quantity of available phosphorus in the soil is much too small to meet the demands of crops. In such soils a combination of nitrogenous and phosphatic fertilisers gives a much higher yield.

The quantity of available phosphorus in most soils is sufficient to meet the needs of small sized crop, but when a higher level of production is desired the supply of available phosphates becomes much too small and it is necessary to give an extra quantity in the form of fertilisers.

In the case of phosphatic fertilisers the crop is usually able to utilise about 10 to 12 per cent only of the quantity added, the rest being converted into a form not readily available to the plants. Though attempts are made to make phosphates contain in naturally occuring phosphatic fertilisers more soluble by treatment with acid and conversion into super phosphates, the phosphates revert to the insoluble form in the soil. Attempts are being made to get over this by recommending the 'Placement' method of application. This method is applicable mainly for line sown crops but becomes less useful for broadcasted crops and transplanted crops like rice.

Reversion of super phosphate can be reduced by mixing it with 20 to 50 times its weight of compost or farm yard manure before applying it to the field. This is done by spreading Super phosphate powder in thin layers say quarter inch thick over alternate layers of, say six inches, of mixed cattle shed refuse or other compost material. The heap or trench so filled up is allowed to ferment for 4 to 6 months after which the manure is well mixed and applied to the field. Fermentation is quickened and the refuse contains a sufficient amount of available nitrogen in the form of cattle urine or nitrogenous fertilizers. When such composted super is applied the growing crop takes up a greater quantity of phosphorus and yields higher than when phosphate is applied with an equal quantity of cattle shed compost without fermenting the two together.

Experiments show that as with composted super phosphate, composting rock phosphate or bonemeal also gives a higher yield of crops when applied along with nitrogenous fertilisers.

Fisheries Section: *Paddy-cum-Fish culture:* A vast stretch of 37 acres of water-logged area called Arupatha odai in Tanjore district, where deep water paddy is cultivated, reveals scope for tremendous possibilities for fish culture in paddy farms. About 300 acres of paddy area have been selected for experiments on fish culture in paddy farms. The experiments on other plots are frequently subjected to disturbances owing to excess supply of water, due to rain and floods. Intensified stocking has been undertaken for increased production of fish, duly considering the limited period before paddy harvest. The experiments are designed to study in a statistical manner, the results and advantages of fish culture with paddy. Randomisation of species and triplicated system to determine and fix the grade and kind of species suited for culture in paddy fields have been undertaken. The progress is being watched.

Tilapia culture: "Tilapia" fish culture in Tanjore division is done in confined waters under the direct supervision of the Fisheries department. A small quantity of 300 Tilapia of size ranging from 1½ inches to 3 inches was stocked on April 11, 1953 in "Webster moat". The Webster moat is a confined watersheet of 3 acres. Large numbers of carps both fry and fingerlings have also been stocked since then to estimate the productivity of the tank and also to study the comparative results of "Tilapia" culture with carps. Periodical observations have been made and they recorded that Tilapia have multiplied rapidly and the present stock has grown to 12·2 inches in size, weighing 1 lb. and 2 oz. It is an interesting feature to observe that the carps stocked have also shown normal growth. A quantity of 778 lb. of carps was marketed during the last three months. Research on the food, growth and breeding habits of Tilapia is being carried out.

Glyricidia Maculata: Gopalakrishna, N. The Farmer, Vol. V. No. 10, P. 35. 1954. *Glyricidia maculata* is an ideal green manure. It grows in to a medium sized tree and can be cut for manure repeatedly. It grows very quickly and does not deplete the soil much. Propagation is done both by cuttings and seedlings, but the former is better. In the case of the latter, seedlings are raised in the nursery in the first week of June and will be ready for planting in about five weeks. Watering is to be done when necessary. Planting the seedlings can be done in pits 12″ × 12″ × 12″ dug 10 to 15 ft. apart on paddy field bunds. The pits are filled with well decomposed farm yard manure or compost prior to planting. Cuttings can also be planted on bunds with the onset of monsoon. Rooted cuttings are better. Once the seedlings or cuttings are established, very little attention is necessary. During the first year watering is necessary in summer. It is relatively free from pests and diseases.

From the second year of planting, about 30 to 40 lb. of green leaves increasing to 200 to 300 lb. in the 5th year can be got from each tree. If the farmer has about 20 trees, the problem of manuring one acre is solved. Under irrigated conditions leaves can be cut twice a year.

Experiments on Artificial Rain in East Africa: D. H. Davis, *Nature* **174,** 1954. Experiments on artificial stimulation of rain have been conducted in East Africa using finely ground hygroscopic salt (mainly common salt) with a fair degree of success.

Balloons were released whenever large cumulus clouds were present. Five balloons each carrying 15 grams of finely ground hygroscopic particles were released into each cloud. The dispersal was effected by the explosion of a small charge of gunpowder ignited by a time fuse. The length of the fuse was adjusted to cause dispersion just above the base of the cloud. Out of 29 seedings conducted in South Kenya, there was light rain on 16 occasions, heavy rain on one and moderate rain on 2 other occasion and no rain on the rest of the occasions. The interval between the explosion and the deservance of rain ranged from 16 to 38 mts. and the duration of rain 3 to 55 mts. Changes in the colour of the cloud were reported in the vicinity of explosion.

Cloud seeding did stimulate rain on the majority of occasions but such rainfall was generally very light or light. Though there was an increase in total rainfall on days of seeding at a distance downward from the fixed point of release of the seeding agent corresponding to a time interval of about 30 mts. introduction of hygroscopic particles into a large cumulus clouds may produce an immediate interference with the rain producing processes in such clouds and this effect might result in a reduction of rain in the immediate vicinity.

Wheat Harvest Made Easy: Bullock-Drawn Machine Proves Popular: *New Delhi:* A bullock-drawn disk harrow type thresher, known by the name of Olpad thresher is becoming popular with farmers for threshing wheat.

The machine takes half the time required for threshing wheat by the usual method of bullock threshing. Unlike the traditional method it is not fatiguing to work this machine. It also provides the additional weight reguired to get a finer type of *bhusa* and helps to crush the nodes of the straw.

The thresher can be pulled over the ordinary threshing floor by a pair of bullocks. The machine, together with a wooden frame, costs Rs. 150/-.—(For I. C. A. R. Farm News, News Release No. 6)

CROP AND TRADE REPORT

Crop Statistics, 1954—'55 Madras State, Gingelly Intermediate: The condition of the gingelly crop is reported to be generally fair in all districts of the State. Early sown crops have been harvested in the districts of North Arcot and the yield was below normal. The yield per acre of the standing crop is expected to be normal in the districts of North Arcot, Coimbatore and Malabar. It is too early to report on yield of the crop in the districts of Tirunelveli and Ramanathapuram. The wholesale price of gingelly seed per standard maund of 82 2/7 lbs. as reported from important market centres on 13—11—1954 was Rs. 24—8—0 at Tirunelveli, Rs. 22—0—0 at Tuticorin, and Rs. 20—0—0 at Cuddalore and Salem. Compared with the prices that prevailed in the corresponding period of last year, these prices reveal a decrease of 33·8% in Salem, 30·2% in Tuticorin, 30·0% in Tirunelveli and 28·6% in Cuddalore.

Early Sowing is Beneficial for Summer Cotton: The major area under summer cotton in the Madras State is found in Srivilliputtur taluk, where it often succeeds a paddy crop raised with the aid of irrigation from wells or tanks. The transplanting or broadcasting of paddy crop in this area is prolonged from September to the middle of November even, depending upon the onset of North East Monsoon filling up of tanks, availability of other irrigation facilities etc. Consequently the sowing of succeeding cotton crop is also delayed to a considerable extent due to delay in paddy harvest and subsequent preparation of the land for cotton. The figures presented in the following table give the mean yield and fibre properties of cotton raised during three sowing dates during the years 1952—1954 at Srivilliputtur with the two improved Cotton strains existing in the tract:

Sowing Period: I Period — I Week of March.
II Period — IV Week of March.
III Period — I Week of March.

Strain	Sowing period	Means for three seasons (1952—'54)				
		Yield of kapas lb/acre	Ginning %	Fibre length (inch)	Fibre weight (millionth of a gm. per cm.)	% Mature Fibres
MCU 1	I Period	1343	32	1 02	1·44	60
	II ,,	787	32	1·02	1·29	52
	III ,,	455	31	0 97	1·20	22
MCU 2	I Period	1366	33	1·04	1·39	61
	II ,,	694	31	1·03	1·21	47
	III ;,	518	31	1·00	1·05	22

It would be clear from the table that the first sowing period (i. e. crop sown during I week of March) register not only the highest mean yield per acre, but also records the best fibre properties, consistently in both the strains. Hence from the point of view of quantity and quality of harvests also (since Summer cotton from this zone has the reputation of bringing the best quality cotton in the Indian Union at present) it is very necessary that *early sowing of Summer cotton are adopted by all ryots.* This would require not only the early planting of the previous paddy crop but also timely and expeditious preparation of lands for cotton.

(Agricultural News letter, December 1954.)

Weather Review — For the month of November, 1954.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January
North	Madras (Meenambakkam)	1·2	—12 8	35·9
	Tirurkuppam*	0·1	— 9·3	32·9
	Vellore	0·1	— 7·6	26·8
	Gudiyatham*	Nil	— 4·0	37·4
East Coast	Palur*	1·6	—10·6	41·4
	Tindivanam*	Nil	— 7·2	39·8
	Cuddalore	1·1	—14·4	47·0
	Nagapattinam	5·5	—12·0	37·5
	Aduturai*	1·6	— 8 6	36·4
	Pattukottai*	2 0	— 6 5	52·4
Central	Salem	Nil	— 3·8	36·3
	Coimbatore (A. M. O.)*	1·0	— 2·4	25·3
	Coimbatore	3·1	— 0·9	30·1
	Tiruchirapalli	0·7	— 6·3	35·1

Division	Station	Total for the month	Departure from normal	Total since 1st January
South	Madurai	2·1	— 3·6	38·1
	Pamban	4·0	— 7·7	27·3
	Koilpatti*	2·2	— 3·9	33·7
	Palayamcottai	1·3	— 6·1	19·6
	Ambasamudram*	2·7	— 7·3	31·2
West Coast	Trivandrum	0·7	— 6·3	60·8
	Fort Cochin	2·3	— 4·4	115·1
	Kozhikode	2·5	— 4·9	144·8
	Pattambi*	1·1	— 2·8	93·0
	Taliparamba*	0·1	— 3 6	156·3
	Wynaad*	0·1	— 3·9	87·1
	Nileshwar*	Nil	— 3·0	177·3
	Pilicode*	Nil	— 3 1	167·1
	Mangalore	0·3	— 3·6	148·9
	Kankanady*	0·3	— 2·2	149·2
Hills	Kodaikanal	1·7	— 8·5	52·1
	Coonoor*	1·6	—12·2	49·0
	Ootacamund*	0·5	— 3 8	37·2
	Nanjanad*	0·7	— 3·3	56·9

Note:—1. * Meteorological Stations of the Madras Agric. Dept.

The month began with a feeble western disturbance, affecting Baluchistan and Upper Sind. The first three days passed off without any large change in the weather conditions. On 4—11—1954 maritime air spread over the Peninsula, South of latitude 13° North, and rains were fairly widespread in South Tamilnad and Malabar - South Kanara. On the next day an active convergence zone lay off the Coromandel Coast Two days hence maritime air was found confined only to the South of Latitude 8° North. On 9—11—'54 a feeble incursion of moisture took place over South Rajasthan. In the succeeding eight days there were a number of mild western disturbances. The zone of convergence over Tamilnad extended at 5000 feet above sea level from Madras to Cochin on 18—11—54. Rains were fairly widespread in South Tamilnad and localised in Travancore-Cochin in the succeeding two days. Except a few minor western disturbances there was nothing worth recording in regard to the weather conditions in the remaining portion of the month.

As regards the performance of the North-East monsoon in the Madras State, it is to be recorded that it is far from being satisfactory throughout the State. In certain districts like Chingleput, North Arcot, Tanjore, Tiruchirapalli, Ramanathapuram and Tirunelveli the retreating monsoon was a miserable failure. The crops suffer due to want of rains. The minor irrigation sources have failed with the result that acute difficulty is being felt to irrigate the crops.

The note-worthy rainfalls and the zonal rainfall for the month are furnished here-under:

Note-worthy Rainfalls			Zonal Rainfall			
Date	Name of Place	Rain-fall	Name of Zone	Av. rainfall for Nov.	Dep. from normal	Remarks
2/11/54	Tuticorin	1·5	North	0·4	— 8·4	Far Below normal
3/11/54	Cochin (Wellingdon Island)	3·0	East Coast	2·0	— 9·9	do.
do.	Kozhikode	2·0	Central	1·2	— 3·4	do.
4/11/54	Coimbatore	3·0	South	2·5	— 5·7	do.
do.	Mathurai	1·5	West Coast	0·7	— 3·8	do.
5/11/54	Madras (Nungambakkam)	2·0	Hills	1·1	— 7·0	do.
8/11/54	Alleppey	2·0				
18/11/54	Nagapattinam	1·5				

Agricultural Meteorology Section,
Lawley Road P. O.,
Coimbatore.

C. B. M. & M. V. J.

DEPARTMENTAL NOTIFICATIONS

Gazetted Service — Postings and Transfers

Name and present post	Posted as
Daniel, F. L., Asst. Chemist, Coimbatore,	Compost Dev. Officer, Madras.
Francis, T. S., Asst. Mark. Officer, Coimbatore,	Regl. Dy. Director of Agriculture, Madurai.
Govinda Kurup, K., Addl. D. A. O., Trichy,	A. D., Manjeri.
Thomas, K. G., Addl. D. A. O., Tanjore,	D. A. O., Madurai.
Krishnamurthy, R., Addl. D. A. O., Madurai,	Agronomist, A. R. S., Satyamangalam.
Mohamad Abbas, U. B., (On leave)	Asst. Marketing Officer, Coimbatore.

Upper Subordinates — Postings and Transfers

Name and present post	Posted as
Annaswami, N., S. D. A., Musiri,	A. D., Varagoor.
Anandam Pillai, S., A. D., Melur,	A. D., Dindigul.
Abdul Latheef, A. D., Kollegal,	A. D., Rajapalayam.
Allagappa Pillai, S. A. D., Ramnad,	A. D., Sathangulam.
Annaswami, S., S. D. A., Tinnevelly,	A. D., Kadambur.
Anantachari, P. S., S. D. A., Vellore,	A. D., Perungathoor.
Avudaynayagam, Spl. A. D., Orthanad,	A. D., Thethurai.
Arumugam, M., Spl. A. D., Shiyali,	A. D., Pernamallur.
Achuthan, V., A. D., Allathur,	A. D., Tirur.
Ananthalrayanan, A. D., Gudalur,	Fruit Asst. Coonoor.
Abubucker, D., Gandhigram,	A. D., Arkonam.
Balasubramaniam, K. M., Asst. in Paddy, Mangalore,	Asst. in Paddy, Coimbatore.
Balasubramaniam, R., P. P. A., Madurai,	Asst. in Vegetables, Coimbatore.
Chami, A., A. D., Srivelliputhoor,	A. D., Ilayangudi.
Choudappa, S. R., Spl. A. D., Peravurni,	A. D., Uthukuli.
Davidar, J. S. C., Spl. A. D., Guindy,	A. D., Poonamalli.
Dorairaj Ratnam, Spl. A. D., Tinnevelly,	A. D., Devipatnam.
Doraiswami, G., A. D., Gobi,	A. D., Bhavani.
Doraiswami, R., A. D., Bhavani,	Exten. Officer, in Agriculture, Salem.
Elumalai, T., Spl. A. D., Guindy,	A. D., Perambakam.
Edwin Amirtharaj, A. D., Palni,	A. D., Theni.
Ernest, R. S., A. D., Tirupur,	A. D., Sulur.
Fernandez, A., S. D. A., Koilpatti,	A. D., Melapattam.
Govindaswami, T. N., A. A. D., Sathiathope,	A. D., Ulandurpet.
Gobinath, M., S. D. A., Palghat,	A. D., Ginlandy.
Gopalakrishnan, K., A. D., Palghat,	A. D., Choughat.
Govindarajan, Paddy Asst. Palur,	A. A. D., Panruti.
Gopalakrishnan, K., A. A. D., Buntwal,	Botany Asst., Coimbatore.
Ganapathy, T., Spl. A. D., Tirupur,	Spl. Asst., Udumalpet.
Herald Vedanayagam, Spl. A. D., Tanjore,	A. D., Mudukalathur.
Hariharan, S. V., A. D., Ambasamudram,	A. D., Trichengode.
Haridass Menon, Spl. A. D., Nannilam,	A. D., Palakode.
John Thiruthuvaraj, A. A. D., Srirangam,	A. D., Karaiyur.
Jagath Chander Shetty, A. D., Coondapur,	A. D., Kollegal.
John Knight, A. D., Walajah,	Fruit Asst., Thimmapuram.
Joseph, J. B., A. D., Dindigal,	A. D., Natchiarkoil.
Krishnamurthy, P. S., A. D., Tiruvellore,	A. D., Oothukottai.
Krishnan, S., A. A. D., Sholavandan,	A. D., Natham North.
Kollappa Pillai, S., Spl. A. D., Melur,	A. D., Abiramam.
Karupanan, P. M., A. D., Salem,	A. D., Vilathikulam.

Name and present post	Posted as
Kannan, S. D. A., Salem,	A. D., Uthankarai.
Kuppuswami, V. N., A. A. D., Vellur,	A. D., Puduchatram.
Kunhi Mohd, Exten. Officer, Payanur,	A. D., Kozhikode.
Kuriakose, T., A. D., Perintalmana,	A. D., Mannarghat.
Kuttisankaran, M. P., A. F. M., Kulitalai,	A. D., Nambiur.
Kolandaiswami, S. A. D., Pudukottai,	Exten. Officer in Agrl., Trichy.
Krishnankutti, K. S., A. D., Choughat,	do. Malabar.
Krishnaswami Sarma, M. C., F. M., Central Farm, Coimbatore,	F. M., Satyamangalam.
Kannan Nambiar, P., P. A. to D. A. O., Tellichery,	A. D., Cananoor.
Mohd Fathauddin, A. A. D., Rajapalayam,	A. D., Gummidipundi.
Mohd Habeeb, S. B., A. D., Musiri,	A. D., Manigandam.
Mahoob Alikhan, Spl. A. D., Kanur,	A. D., Aravakurichi.
Mahadevan, A. A. D., Thandigudi,	A. D., Keeranur.
Mukundan, T. K., S. D. A., Shoranur,	A. D., Pattambi.
Matthews, V. G., A. A. D., Kalpetah,	A. D., Cheyyur.
Manimanthri, C., A. D., Trichengode,	Exten. Officer in Agrl., Tirunelvely.
Mukta, M., Asst. in Tuber, Mangalore,	Asst., in Paddy, Tirurkuppam.
Moosa Berami, A. D., Khozhikode,	Exten. Officer in Agrl., Payanur.
Muddappa Gowda, P., S. D. A. Gobi,	do. Ramapuram.
Mahadevan Piliai, A. A. D., Vedasandur,	Cotton Asst., Koilpatty.
Nanjayan, K., A. D., Tirukoilur,	A. D., Melalokur.
Narayana Nambiar, P. K., Spl. A. D., Lalgudi,	A. D., Thirumalavadi.
Natarajan, C. T., Spl. A. D., Kulitalai,	A. D., Nirpalani.
Nagarajan, S. S., A. D., Athur,	A. D., Keelamangalam.
Narayana Nambisan, Spl. A. D., Sholavandan,	A. D., Mettur.
Narayanan, A., A. D., Ramanathakara,	A. D., Taliparamba.
Narayanankutty, K. G., A. D., Tellicherry,	A. D., Kunnamangalam.
Narayanan, C. K., Spl. A. D., Tiruturaipundi,	A. D., Peravurni.
Perumal, A. S., A. D., Sankarankoil,	A. D., Tuticorin.
Ponniah, S., Spl. A. D., Tirunelvely,	A. D., Radhapuram.
Pattathan, A. D., Kasarkode,	A. D., Puthoor.
Pattabhi Raman, A., A. D., Perundurai,	A. D., Kodumudi.
Padmanabhan Nambiar, A. D., Cannanoor,	A. D., Melapattam.
Radhakrishna Reddy, A., A. D., Saidapet,	A. D., Villivakkam.
Rangaramanujam, N. A., A. D., Panruti,	Exten. Officer in Agrl. Chingleput.
Ramadurai, C. N., Spl. A. D., Cuddalore,	A. D., Penadam.
Rathinasabapathy, A. D., Pudukottai, East,	A. D., Pudukottai.

Name and present post	Posted as
Radhakrishnan, M., Spl. A. D., Uthamapalayam,	A. D., Keeranur.
Ranganathan, A. K., Spl. A. D., Trichy,	A. D., Kananancor.
Ranganathan, P., A. A. D., Othakadai,	A. D., Palamedu.
Ramaswami, P. C., Spl. A. D., Tirunelvelly,	A. D., Thirupuvanam.
Ramakrishnan, M. S., Spl. A. D., Ambasamudram,	A. D., Vijayanarayanan.
Rajamanickam, S., A. A. D., Katpadi,	A. D., Vaniambady.
Ranganathan, C., Spl. A. D., Kumbakonam,	A. D., Thandarampet.
Rangaswami Reddy, S., A. D., Srivaikuntam,	A. D., Salem.
Ramachandra Poduval, A. A. D., Shoranur,	A. D., Thiruvengadi.
Ramakrishna Sarma, V., A. A. D., Belthangudi,	A. D., Kasargode.
Ramanathan, A. D., Madras,	Exten. Officer in Agri. Chingleput.
Ramadass, A. A. D., Periapalayam,	Exten. Officer in Agri. N. Arcot.
Ramakrishnan, S., A. D., Nathan,	do. do. Coimbatore.
Raghu Shetty, A. D., Kasarkode,	do. do. S. Kanara.
Raman, K. R., Fruit Asst., Thimmapuram,	Fruit Asst., Periakulam.
Ramaratnam, R., A. D., Vegetables,	A. D., Saidapet.
Ramachandra Marar, Lec. in Agrl.	A. D., Ootacamund.
Rajan, M., Spl. A. D., Pattukottai,	Exten. Officer in Agrl. Gudimangalam
Radhakrishnan, T. V., C. C., Inspector, Sankarankoil,	A. D., Udamalpet.
Sampath, V., Fruit Asst., Kallar,	Govt., Garden, Ootacamund.
Sivasubramaniam, S. D. A., Guindy,	Exten. Officer in Agri., Chingleput.
Sundararajan, M. S., A. A. D., Thirukazhukundram,	A. D., Thiruporur.
Shanmugam, C. T., A. D., Chingleput,	A. D., Madurantakam.
Sryan Kumaran, S., A. D., Kallakurichi,	A. D., Rishivandyam.
Solayappan, B., A. D., Chidambaram,	A. D., Kumarakshi.
Soundararajan, R., A. A. D., Thuraiyur,	A. D., Thirumayam.
Sivasubramaniam, P. K., S. D. A., Trichy,	A. D., Alangudi.
Somayan, J. B., A. D., Natchiarkoil,	A. D., Palni.
Seshadri, P., Spl. A. D., Madurai,	A. D., Ramanathapuram.
Somasundaram Pillai, K., A. A. D., Virudhunagar,	A. D., Reddipatti.
Shoukat Ali, S. D. A., Sathur,	A. D., Karaikudi.
Shanmugavelu, B., Spl. A. D., Madurai,	A. D., Peravur.
Sivaramakrishnan, N., A. A. D., Cheranmadevi,	A. D., Srivaikuntam.
Subramaniam, T. N., A. D., Chengam,	A. D., Arcot.
Srinivasan, N. R., Exten., Officer in Agri. Ooty,	A. D., Chengam.

Name and present post	Posted as
Sundararajan, S., Spl., A. D., Tanjore,	A. D., Kunnathur.
Shanmugam, S. P., Spl. A. D., Mayavaram,	A. D., Mandakolathur.
Sivaraman Nair, P. C., Spl. A. D., Papanasam,	A. D., Pernambut.
Selvaraj Carvelho, A. D., Krishnagiri,	A. D., Sangaree.
Sheenappa, K., A. D., Mangalore,	A. D., Coondapur.
Sadasiva Shetty, Y., A. D., Karkad,	A. D., Belthangudi.
Sundaram Pillai, K., A. D., Erode,	A. D., Andhiyur.
Swaminathan, S., Spl. A. D., Tiruvarur,	A. D., Mulanur.
Subramaniam, C. P., A. D., Ponneri,	A. D., Madukarai.
Srinivasan, V., A. D., Kotagiri,	Exten. Officer, in Agri., Ooty.
Sathruddin, A. D., Mudukalathur,	do. do. Ramnad.
Sankaranarayanan, R., Asst., in Paddy, Tirurkuppam,	Asst., in Paddy, Polur.
Subbiah Pillai, R., A. D., Arkonam,	Supervisor, Rasipuram.
Shanmugam, N. Myco., Asst., Coimbatore,	P. P. A., Madurai.
Sankaranarayanan, C., S. D. A., Coimbatore,	Exten. Officer in Agrl., Kinathukadavu.
Subbaya, K. K., A. D., Peravurni,	Ento. Asst., Coimbatore.
Thejamurthy, P. S., (On leave),	A. D., Mailam.
Tanikachalam, T. K., A. D., (On leave),	A. D., Tirukoilur.
Thirumaleshwar Bhatt, N., S. D. A., Mangalore,	Mycol. Asst., Coimbatore.
Thirunavakarasu, R., A. A. D., Arasampatti,	A. D., Paramathi.
Vrishabadass, P., A. A. D., Sankarapuram	A. D., Pakkam.
Venkatachalam, T., Spl. A. D., Musiri,	A. D., Peruvelapur.
Velayudam, A. D., Nilakottai,	A. D., Jayamkondan.
Veeraraghavan, P. P. A., Madurai,	A. D., Vedasandur.
Vasudevan, K. V., Spl. A. D., Tanjore,	A. D., Barur.
Venkataraman, T. M., Fruit Asst., Periakulam,	A. D., Walajah.
Varadarajan, E. N., A. D., Avanasi,	Fruit Asst., Mettupalayam.
Venugopal, Spl. A. D., Udumalpet,	A. D., Sulur.
Usmankhan Ghori, Spl. A. D., Madurai,	A. D., Mettur.
William, P., A. D., Ooty,	Exten. Officer in Agri., Nilgiris.